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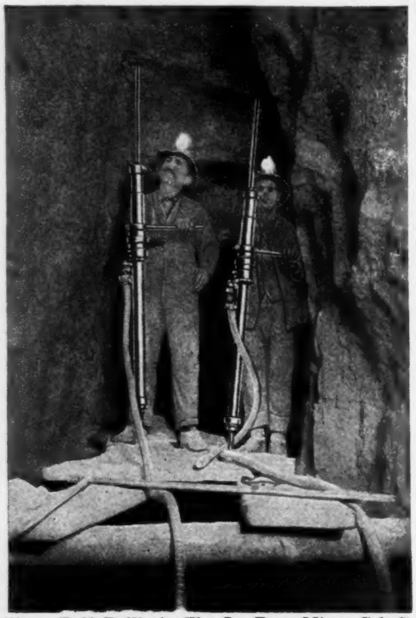
Sullivan Hammer Drills



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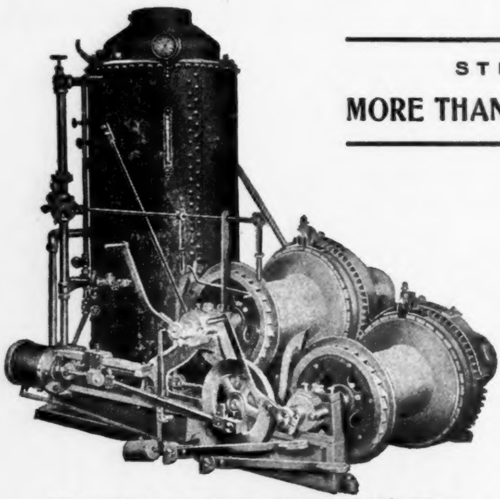

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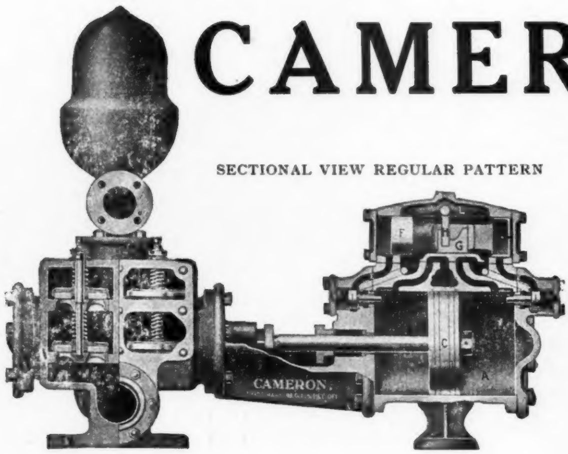

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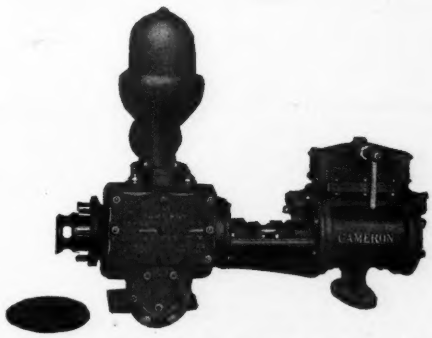

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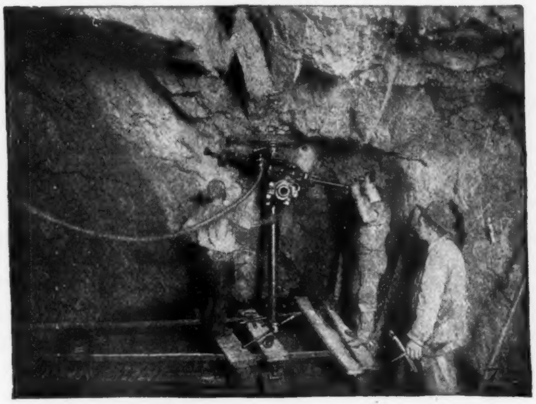

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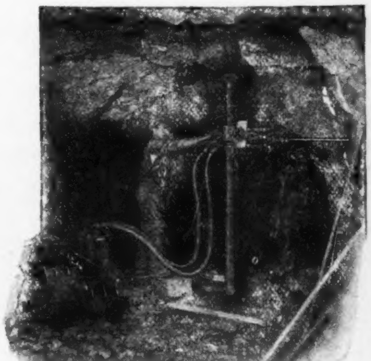

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COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XV — JANUARY, 1910 — No. 1

A NOVEL LOCOMOTIVE ROCK DRILL AND A REMARKABLE DRILLING RECORD

BY FRANK RICHARDS.

Successive "new records" made in rock cutting operations are often not fairly comparable with either preceding or succeeding records elsewhere made, on account of the differences in the conditions under which they are made. Thus the rock-drilling record set forth in the following may not be properly comparable with performances in other cases of rock-drill work. But it is sufficiently striking and notable in itself, and may point the way toward more efficient methods of wide applicability.

This record was made in the work of excavating the Livingstone Channel, a detail of the improvement of the Detroit River. Here was a straight channel to be cut in rock, 300 ft. wide, in the bottom of the river. The contractors for the section in question are Grant, Smith & Company & Locker; the work lies between Amherstburg, Ont., and Grosse Isle, Mich.

The area to be worked over was enclosed by cofferdams at each end, so that the operations were entirely "dry." The entire site was

LOCOMOTIVE ROCK DRILL. DRILLS DEEP HOLES WITHOUT CHANGING STEELS.

commanded by three Lidgerwood cable conveyors movable lengthwise of the channel as the work progressed; these conveyed all the material from the excavation and dumped it at a sufficient distance on either side. The overlying earth and loose stones were first removed by the aid of steam shovels, with which operation we at present have nothing to do, and then there remained a clear surface of rock to be excavated to a varying depth up to 12 ft. and over. The material is a soft lime rock running into dolomite and is unusually free from seams, making it a comparatively easy proposition for the rock drill.

The drilling over the entire surface was all done in a single operation to the required bottom level. In commencing the drilling what might be called a standard equipment was employed, consisting of the usual type of rock drills, air operated, mounted on tripods and requiring two men for each. These drills were moved from hole to hole, usually a distance of about 8 ft., as required. These, of course, required a change of bit for every 2 ft. of depth of hole drilled, and a successive reduction of gage for each additional steel, so that to drill to a depth of 14 ft. and a bottom diameter of 3 ins., seven steels would be required with 3¾ or 3 7-8 ins. for the starter. The actual average rate of the drills on this work was about 46 ft. of hole for an eight-hour shift. Four 3 1-4-in. Ingersoll-Rand drills were crowded all the time to keep one cable conveyor occupied.

The half-tone herewith shows the arrangement which has revolutionized all this. It is the invention of Mr. C. H. Locker, of the firm above referred to. It comprises in fact a single rock drill with a carriage and mounting and air-power devices which enable it to keep at work, actually drilling, as constantly as possible and *minimize the delays* required for shifting from hole to hole, for changing the steels, and for raising the drill by the feed screw when either change is made. This drill has largely made its record by avoiding stops, just as the big through express trains do. It has also the additional advantage of extra weight and power, which would not be practically available in a drill entirely operated and moved about by hand.

As seen in the half-tone, there is a horizontal frame built of heavy timbers and mounted upon four wide-tread wheels, those in front being on a fixed axle while those in the rear are swiveled for steering. There is a vertical air receiver or "air dryer," as they call it, on the rear of the platform and in front of this is a two-cylinder reversible hoisting engine which supplies the power for the several operations required. An extension of the shaft carries a small sprocket-wheel which connects by a chain to a larger sprocket driving the front carrying-wheel when the machine is to be moved. In front is a vertical heavily braced gallows-frame which carries the drill. When everything is in place the preponderance of weight is upon the front wheels, which is as it should be, and when the apparatus is in exact position for starting a hole the two jackscrews seen in front are set down solid upon the rock taking most of the weight and holding everything rigidly in place. The manipulation of these jackscrews is the only hand operation involved when changes of position are made.

The drill used in this case is a 5-in. Ingersoll-Rand machine ("H2"). The first change made in it was to dispense with the usual shell or guide in which the drill cylinder travels up and down by the operation of the slow-acting feed screw. In place of the drill shell the front of this carriage provides vertical guides in which the drill cylinder fits as in its original shell, but with a travel of 10 ft. instead of 2 or 2½ ft. The drill is suspended by a wire cable of suitable size carried to the drum of the hoisting engine, one or two revolutions of which will raise the drill from the bottom to the top of the guides.

A single steel is used of sufficient length to take advantage of nearly the entire vertical travel of the drill cylinder. The feed is entirely by the suspended weight of the drill, a slow retrograde movement of the hoisting drum being accomplished by a worm gear arrangement which can be clutched in or out as required (as is also the fast speed for hoisting the drill and withdrawing the steel from the hole). Holes to a depth of 8 ft. can thus be drilled with a single steel without a stoppage, and the loss of gage in the operation is in this rock scarcely noticeable. For keeping the drill in place when starting there is a guide attached to the front of the machine and brought down quite close to the rock. This guide of course does not fit the steel but gives it a little liberty to dodge around, while still locating the beginning of the hole with sufficient accuracy. The

front half of this guide is hinged and can be swung back out of the way when changing steels.

It is not necessary to describe this apparatus any more in detail. It is evidently a crude and, in a way, merely an experimental arrangement; even the air hoisting-engine was homemade. The machine is already beisg replaced by a carefully designed machine constructed entirely of steel and with additional provisions for economy and facility of operation. However, such as it is it has worked steadily for two or three months or more and made astonishing records.

The following figures are given by a responsible and careful observer. On Sept. 23, 1909, drilling 3-in. holes, 29 ft. of hole was drilled in 55 minutes. This incluuded moving the drill four times, the time occupied in moving being about 45 seconds each. On another day the drill was timed for one hour. Handicapping the drill in this case was dull steel and low air pressure. Yet the first hole was drilled to a depth of 7 ft. 8 ins. in 7½ mins., the next hole was 6 ft. 6 ins., in 26½ mins., and at the end of the hour, with five moves, 37 ft. 3 ins. of holes had been drilled.

The following is from another observer: In 32 mins. it put down three holes, 6 ft. 2 ins., 7 ft. 2 ins. and 7 ft. 2 ins., and was moved three times, leaving it ready for the fourth hole, all in 32 mins. In this time there was a delay of 4 mins. caused by the driller neglecting to raise his bar and getting it bent.

The 6 ft. 2 in. hole in this case from start to finish took 5¼ min. The time of moving, that is from when one hole was finished until another was started, was exactly 2 mins.

The performance of this machine is more strikingly expressed, however, by the following statement: Operated by two men, it took the place of the four tripod drills and eight men, and easily kept well ahead of the conveyor at all times. Its work compared with the tripod drill was approximately as *five to one*. The saving of air consumed has not been investigated.

On the new machine a reheater will be installed, and also a supplementary compressor to generate high-pressure air to follow the drill into the hole and blow out the dust.

EMERGENCY OXYGEN CUP FOR MINERS

The half-tone here reproduced from the Scientific American shows a life-saving apparatus invented by Mr. Clarence Hall, who is in charge of the explosives experiment station at Pittsburg. The device is a simple appliance which generates sufficient oxygen to sustain life for half an hour or so under any conditions of atmosphere. When it is used in an emergency it will guarantee an extension of

INDIVIDUAL OXYGEN SUPPLY.

life for a time extending to half an hour or even an hour, while a man is fighting his way to the open or awaiting the coming of rescuers.

Mr. Hall was lighting the lamp of an automobile when the idea occurred to him to generate oxygen just as the acetylene for his lamp was generated, and providing the means of supplying the oxygen to miners or others whose supply of air fails them. There is in the apparatus accordingly a water chamber, and below it a compartment filled with sodium peroxide.

When the emergency rises a stopcock is partially turned, the water comes in contact with

the chemical and oxygen is liberated. It is passed through the water, which cools it and then it goes to the mouth and nose which are covered by a mask such as is fitted to the face when gas is administered by a dentist. Oxygen may thus be supplied that will keep a man going for at least half an hour while he fights his way out of gas or smoke.

Mr. Hall as a representative of the government studied many of the great disasters in mines that have occurred in recent years. At Mononga, where more than three hundred men lost their lives in December, 1907, he found that the vast majority of the men had died by slow suffocation long after the explosion. Many of these had crawled for great distances on their hands and knees, for the miner knows that the best air is near the ground. Their trousers were worn through at the knees, and their blood marked their trails. Their fingers were worn through to the bone from crawling.

Of all men who die in mines, ninety per cent. meet death through suffocation. There are in the United States 700,000 men who work in coal mines. Many of these are daily subjected to the danger of suffocation. Every year 4,000 of them go to their deaths in this way. The ordinary safety devices are expensive. The men cannot have them always at hand, even if they could afford the expense. The new device can be slipped into the coat pocket, and kept with the coat and lunch basket, always within reach.

The explosion experiment station which Mr. Hall is in charge of, has among other arrangements a large chamber in which all sorts of poisonous gases may be confined, and into which men are sent to demonstrate different appliances. Various kinds of oxygen helmets which will keep a man going for two hours were tried out here.

In this demonstration chamber Mr. Hall burned excelsior in the chamber until the smoke was so thick that the eye could not see four inches through it. Then he donned his oxygen-producing device and went in. He remained here quite comfortably for fifteen minutes. Then the smoke pained his eyes and drove him out. The device continued to generate oxygen, and other men entered the chamber with entire safety for more than half an hour.

APPLICATION OF ELECTRICITY FOR PURIFYING AIR

BY J. W. BUZZELL, ASSOC. M. AM. SOC. C. E., AND WILLIAM H. LARKIN, JR., M. AM. SOC. M. E.

Notwithstanding the wonderful strides made in the reduction of cost and time by the use of machinery, mixed concrete is still conveyed into place by the same crude, slow and expensive methods that existed from the first, namely, wheelbarrows, carts, cars, buckets, chutes, etc., requiring enormous proportional outlays for runs, trestles, railways, engines, derricks, and other plant, as well as cost of operation and maintenance of same. These crude methods have other marked disadvantages. Concrete handled by wheelbarrows, carts, buckets, etc., is subject to considerable waste and tends to set in transit, particularly where transported considerable distances, as is frequently the case. Concrete construction is often from necessity carried on in cold weather subjecting the concrete to the danger of chilling; therefore, any apparatus that conveys the mixed concrete instantly from the mixer into place is particularly desirable.

With the idea of devising some method by which the transportation of the concrete mixture might be simplified the writers of this article some years ago started experiments on forcing the wet mixture through pipes by means of compressed air. The writers were then engaged in the construction of a difficult piece of concrete work where it became necessary to place the concrete by causing it to flow through a long length of pipe placed in an approximately vertical position. It was thought at the time that if the force of gravity would cause the concrete to flow downward through the pipe, there was reason to believe tat concrete could be made to flow through a pipe in any position when acted upon by some force other than gravity, such as steam or air pressure.

This conclusion was not arrived at until considerable experimenting along other lines had been done. The first trials were made by attaching the suction end of a large centrifugal pump to the discharge end of a concrete mixer, which scheme proved to be a failure, due to the fact that the stone separated from the sand and cement and discharged separately. The first encouraging results were brought about by attaching a large steam pipe to the pump casing, thereby introducing a

pressure into the body of the pump which acted upon the mass of concrete in it, causing it to discharge in a more satisfactory manner. These experiments led to the design and trial of a cylindrical receptacle provided with a sealable opening at the top for the admission of mixed concrete, a discharge pipe and valve at the lower end and means for introducing pressure at the top. The discharge pipe at the lower end led to the place where the concrete was to be deposited. Upon applying pressure the concrete was instantly forced through the pipe and deposited in the same condition as when introduced into the receptacle. Many minor difficulties were encountered during the experiments, which, however, were overcome and patents were secured on the process and apparatus.

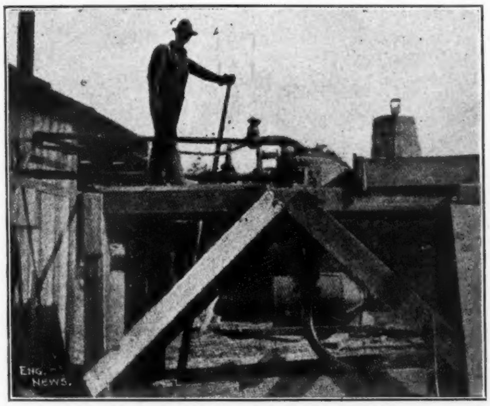


FIG. 1.

In order to obtain necessary engineering data, other more elaborate experiments were conducted using the same type of apparatus and covering a period of several months, during which the photographs reproduced in the accompanying half-tones were taken.

The device used in the experiments consisted of an iron tank (Fig. 1) provided at the top with an air-tight gate, on the side with a pipe entrance for the compressed air and at the conical bottom with an exit pipe for the concrete. Concrete was first mixed on a board at the top of the hopper and poured into the tank through the upper gate which was then battened tight. Simultaneously, then, valves on the intake air pipe and the outlet concrete pipe were opened and the compressed air forced the concrete out of the tank through a 4-in. pipe, to the point of exit. The 4-in. pipe used to transmit the concrete was about 400 ft. long and contained several 90 degree bends and one 180 degree bend with a 4-ft. radius. There seemed to be no obstacle to

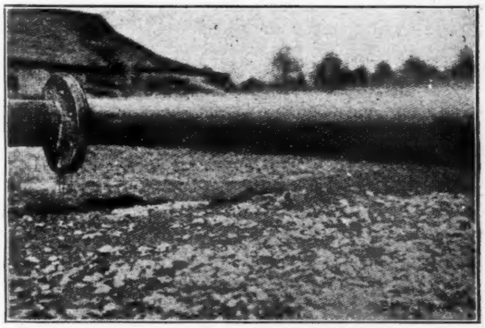


FIG. 2.

the use of a much longer pipe had it been convenient at the time and place.

Tests were carried on with air pressures up to 100 lbs. per sq. in., but it was found that 50 lbs. was the most efficient. Under this pressure the concrete mixture was forced out of the end of the pipe in a well-mixed mass, but at a velocity too great for practical work (Fig. 2). To reduce this velocity a nozzle, such as shown in Fig. 3, was devised. This is simply a plank box with a curved upper cover which diverts the fast-moving stream of concrete and drops it, thoroughly mixed, on the ground or, on actual work, within the forms.

The concrete was hand mixed, of 1:3:5 pro-

FIG. 3.

portions, and was made with stone up to 2-in. diameter. About as much water was used as in ordinary reinforced-concrete work, that is, it was a fairly wet mixture.

The main object of these experiments was to determine the amount of power necessary to convey concrete through pipes of different sizes and lengths; and the coefficient of friction between the concrete and the pipe so as to make possible the use of Bernoulli's Theorem in the design of other apparatus.

Inasmuch as during experiment concrete was deposited without difficulty at a height of about 100 ft. above the mixer through a vertical pipe line it is reasonable to assume that it can be conveyed by this means to any height that would be encountered in ordinary construction.

The process of making concrete resolves itself naturally into several separate and distinct divisions, namely: Manufacture of cement; the handling of cement, sand and stone; meausring, feeding and mixing the aggregates; conveying and placing the concrete. The invention of the rotary kiln, and numerous devices for measuring, feeding and mixing the aggregates, has reduced the cost of concrete to a point where it is now used on all classes of construction. Inasmuch as the greatest factor in the present cost lies in the conveying and placing of the concrete it would seem that these experiments in pneumatic conveying offer a solution of the problem of still further reduction in cost, as statistics obtained during these experiments show that on works of even moderate magnitude concrete can be conveyed by pneumatic means for less than 10 cts. per cu. yd.—*Engineering News* (slightly abridged).

APPLICATION OF ELECTRICITY FOR PURIFYING AIR

New applications of electricity are being discovered daily but not every new application is of such interest or importance as one recently developed for purifying the air of reading rooms, theatres and other close places where large numbers congregate. The apparatus referred to is the ozone generator made by the National Air Filter Co., Chicago, a large installation of which was recently made in the Chicago Public Library to purify or ozonize the 10,000 cubic feet of air per minute that is forced into the main reading room. Dr. W. A. Evans, health commissioner of Chicago, declared that the air in the library building prior to the installation of the apparatus was entirely unfit for use, being foul and dangerous, and probably no other building in the city has been subjected to more condemnation because of its defective ventilating system than it. After the installation of the ozonizing apparatus it was found that the main reading room was completely deodorized, the air being freed of that disagreeable and deleterious odor which for years had so thoroughly permeated all papers, books, furnishings, etc., in this large room. The fresh sterilized "mountain" air in the room reduced the humidity during the hot, oppressive days of summer, and greatly increased the comfort of the readers and employes. The installation renders the disinfecting of all books, periodicals, papers, etc., on the shelves, racks, tables, etc., an automatic process, keeping them constantly in a hygienic condition.

The ozone generator is installed in the large air duct and measures 6 feet high, 11 inches thick and 1 foot wide; it consumes 6.5 amperes of current per hour while ozonizing 15,000 cubic feet of air per minute. A connection is made with a feed wire of 110 volts to a step-up transformer which discharges a current at a potential of 7,000 volts. The high-tension current feeds into a series of electrodes made in the form of ordinary hairbrushes. A static electrical discharge is maintained playing against a series of glass plates. Through this blue electrical discharge of 7,000 volts, air is forced, the result being that all bacteria, germs, etc., are electrocuted. When the filtering electrodes become dirty or clogged they are simply rubbed together and cleaned as one would clean an ordinary hair brush. The generator is placed between the fan and the spray of water used in washing the air, to prevent losing the ozone which the water would otherwise naturally take up.

The low consumption of current and consequent low maintenance cost makes the ozone generator feasible for purifying the air of shops, mills and factories where difficulty is experienced in supplying air in large volume free from odors. It is of commercial importance for preserving and restoring food and other products affected by odors or quickly tainted by decay. Ozone has been found to completely deodorize stale milk, cream, butter and other creamery products, and other uses for the process are constantly being discovered. It is being used for aging wine, curing tobacco, tanning hides, purifying water, etc.—*Machinery.*

COMPRESSED AIR FOR CLEANING AND PAINTING METAL

The following we take from a report by Mr. George L. Fowler to the American Bridge and Building Association. It will be seen that the writer strenuously objects to the use of compressed air for the painting operation, giving substantial reasons for his objections, which are all based upon the moisture in the air, and it would seem that if the air were dried by any means it might still be satisfactorily employed.

I have found, he says, the air spraying system of painting to be very injurious to the durability of oil paints. Paint can be laid by this process quite smoothly, but it will not last. The reason is a simple one:

Air always contains more or less moisture in suspension and the warmer the air, the greater the quantity that can be so held. Hence, an atmosphere that may be warm will be perfectly clear, even though the amount of contained moisture may be very high. But, if that air is cooled, clouds and fogs immediately appear because of the precipitation of the moisture.

This is what happens in painting with compressed air. The warm compressed air is usually pretty well saturated with moisture. As it leaves the spraying nozzle, it at once expands and, in so doing, its temperature falls, and some moisture is precipitated. This moisture is, at the time, intimately mingled with the particles of paint and is thus imprisoned in the film that is formed on the surface. The result is moisture in the body of the paint and rapid deterioration.

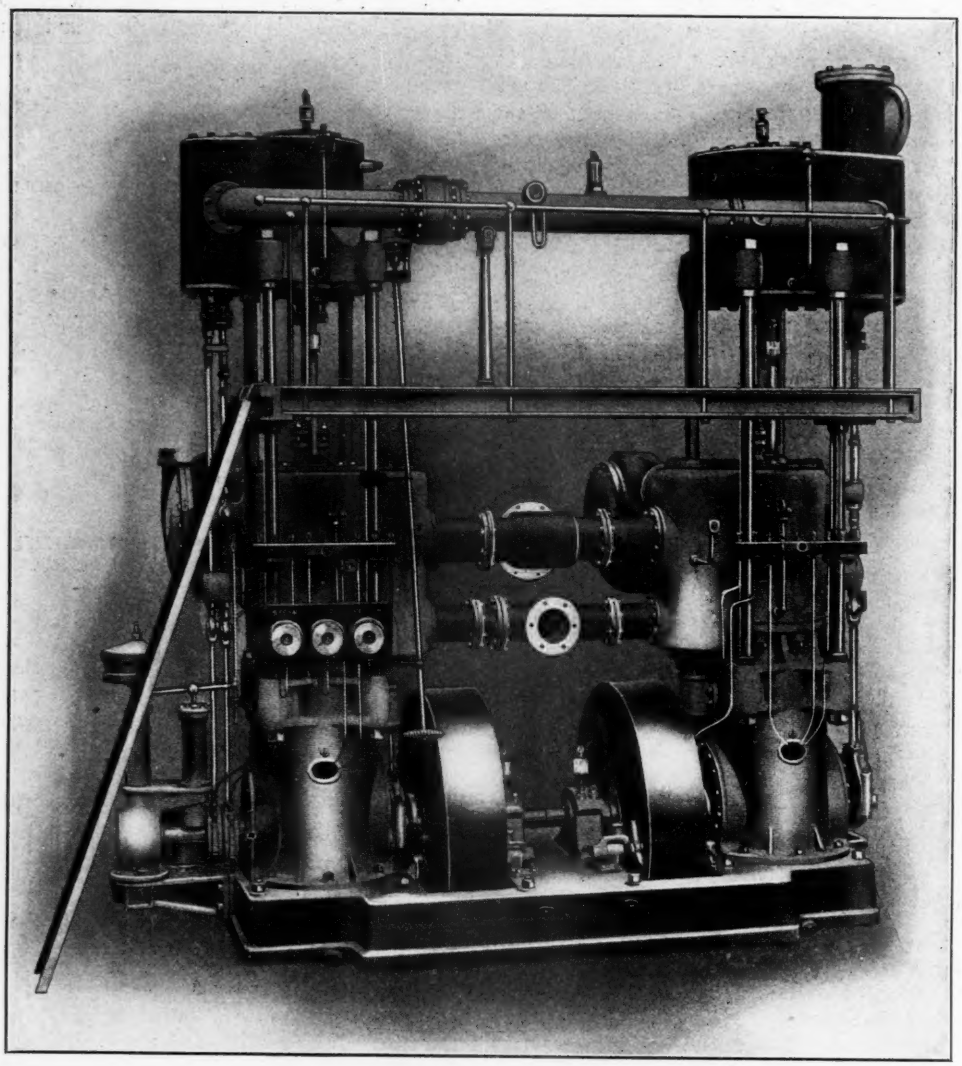
For cleaning, that is by sand blasting, there is nothing that equals it. In fact, I know of no other way in which a surface can be properly prepared. Wire brushes simply cannot remove the rust and, even if they could, they would leave the surface so covered with a fine dust, that any paint laid over it would have the elements of its own destruction embedded in it. But the residue of rust is the principal evil to be guarded against. For example: In some of my investigations I had subjected a paint to an action for several months without apparent injury other than a dulling of the surface gloss. It appeared to the eye to be in proper condition for repainting. Before doing this, however, I examined it under the microscope and found it to be totally unsuited for repainting. I found that minute blisters had arisen on the surface and that many of these had burst, leaving a small crater-like hole in the center. This hole was about 1-2000 in. in diameter, but down in the bottom of it I could see the red rust that had formed on the bared metal. If, then, the plate had been repainted, there would have been a rapid deterioration of the surface and for no apparent reason. You can see, then, that this serves as an explanation why it so frequently happens that the repainting of a structure with the same paint originally used is so unsatisfactory while the original painting was all that could be desired. Scraping and using a wire brush cannot get at these microbes of deterioration, as they may be called, and I know of nothing but sand-blasting with compressed air that will.

A VERTICAL CROSS COMPOUND STEAM AND DUPLEX TANDEM TWO STAGE AIR COMPRESSOR

The half tone and the large line cut here reproduced from The Engineer, London, show the essential features of an interesting air compressor recently built by W. H. Bailey & Co., Limited, Manchester. The air and the steam cylinders are here combined in such a way that the whole may be operated together as a compound machine or either side may be operated separately. The steam cylinders being mounted above the air cylinders, their expansion and contraction do not affect the air cylinders or other parts of the machine.

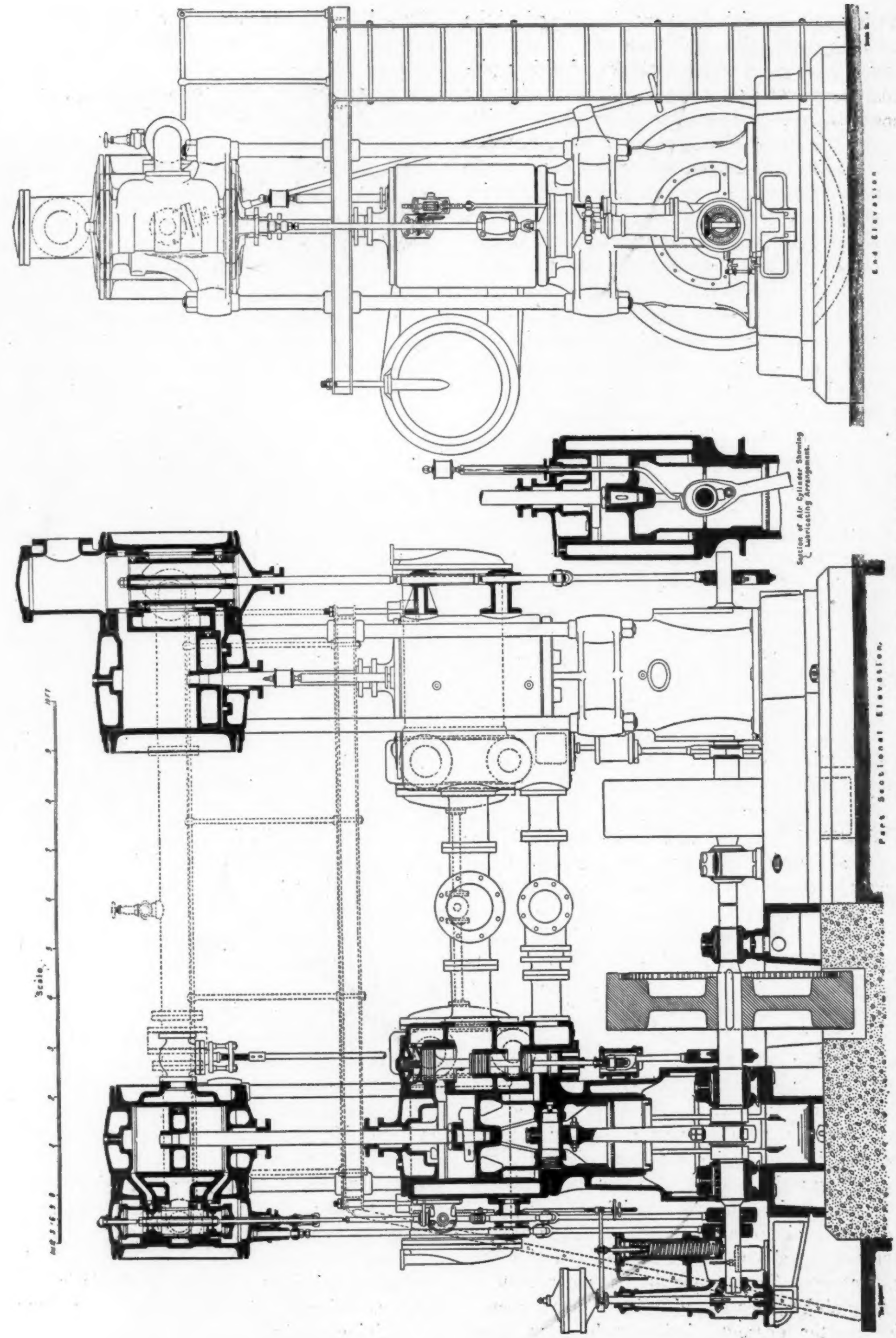
While the steam cylinders are, of course, removable, the air cylinders also can be entirely removed without disturbing the steam cylinders. Both the steam and the air cylinders have piston valves. The point of cutoff for the steam to the high pressure cylinder is governed by a combination of the running speed and the air pressure, and it can be adjusted while the machine is running by a variable expansion gear.

There is a separate eccentric for each steam and each air cylinder. Free air is drawn into the space on top of the differential compressor piston through the upper port, the piston valve being above the port at the time. When the air piston arrives at the end of its stroke the piston valve in descending closes the top port, and on the return stroke the air drawn



CROSS COMPOUND STEAM AND TWO STAGE AIR COMPRESSOR.

in as above mentioned is compressed on the up-stroke of the large piston to about 27 lb. per square inch. The piston valve then descends, and the top port is uncovered to allow the compressed air to flow past the spring valve at the top to the intercooler. This concludes the first stage of the operation. The air next passes from the intercooler to the suction side of the small high-pressure end of the piston, which is an annular space representing the difference in the diameters. When the piston descends, the second and final stage of compression to 100 lb. per square inch is effected. A movement of the piston valve next allows the compressed air to be discharged into the delivery pipe. There are three fixed points in the compression cycle, namely, the opening of the inlet, the closing of the inlet, and the closing of the discharge, which are positively and mechanically controlled. The opening of the discharge, which is the only variable point in the cycle, is controlled by an automatic



VERTICAL SECTION AND END ELEVATION OF COMPRESSOR.

spring valve, which, however, is relieved of the necessity of quick and therefore noisy closing. During the suction stroke of either piston, the lower or the upper valve occupies the space between the cylinder port and the spring valve, reducing clearance to a minimum by discharging the compressed air left in the space through the delivery valves. The makers claim that the proportions of the cylinders are such that the load is equal for both strokes. Computations based upon the mean effective pressures in the air cylinders make the work for the down-stroke much the greater, but this is compensated for by the unbalanced weight of the reciprocating parts. The bearings and connecting-rodends are lubricated by means of a pump, which circulates the oil, and the crosshead of the differential air piston on each side is oiled by the special telescopic pipe fitted in the cover of the cylinder, as shown in the detail sectional view in the cut.

This compressor was for some reason built to metrical measurements, the following being the principal dimensions:

H. P. steam cylinder....400 mm. dia.
L. P. steam cylinder....600 mm. dia.
Differential air pistons..515 and 415 mm. dia.
Stroke ....450 mm.
Capacity, 950 cubic feet of free air per minute when running at 155 revs. per min.
Volumetric efficiency ...93 to 96 per cent.
Mechanical efficiency ...88 per cent.

AIR BRAKE PUMP EXHAUST CHANGE

On all locomotives the air brake pumps are operated by steam, and it has been the practice to conduct the exhaust steam from the pumps to the smoke box, to which the stack is attached, and then to release, causing a draft, the use of the main exhaust in the same way being an important function, when traction power is required. Considerable work is done by the brake pumps when the locomotive is at a standstill or when the train is running down grade, the steam then used often saving the safety valves from blowing off, while any increase of draft under those conditions is, of course, wasteful of fuel. On one hundred and fifty locomotives of the Lehigh Valley Railroad the brake pump exhaust has recently been changed to deliver outside instead of inside the smokestack. Tests show that the company is saving about 1,000 pounds of coal per locomotive on the descent of the grade from Glen Summit to Penn Haven Junction, twenty-six miles.

CONCRETE SHAFTS THROUGH QUICKSAND*

SMITH SHAFT.

The Cleveland-Cliffs Iron Mining Co., in the spring of 1907, made preparations to sink a timber drop shaft, near Princeton, Mich., and knowing the ground to be saturated with water, it was thought advisable to make a few tests. Several 6-inch pipes perforated most of their length were sunk a number of feet into the ground at the proposed site of the shaft, and two special Cameron pumps were connected to some of these pipes. Pumping was then started and continued for some time, a careful observation being exercised on the height of the water in one of the pipes which was not connected to the pumps but was left open for this purpose. Continuous pumping lowered the level of the water so little that the mining company concluded that it would be a difficult operation to sink a shaft by the ordinary drop-shaft methods, and a contract was entered into with the Foundation Company, of New York, for a reinforced-concrete shaft of rectangular cross-section, 15 ft. 4 in. × 11 ft. 4 in. The Company decided to use the pneumatic caisson, or compressed-air system, in sinking this shaft.

Plans were submitted and accepted by the mining compnay for a reinforced-concrete shaft. The specifications required principally that the shaft should be carried down plumb and water-tight, and that when the ledge was reached a water-tight joint should be effected between the shaft and the ledge, and the contract allowed 90 days for completion.

In dimensions the shaft was 21 ft. 4 in. × 17 ft. 4 in. outside, with walls 3 feet in thickness at the bottom and 1 ft. 6 in. at the top, and the concrete was started on top of a timber shoe or cutting edge which consisted of two layers of 12 in. × 12 in. fir timber, beveled on the inside, the bottom stick being shod with a heavy angle bar, the whole being strongly bolted horizontally and vertically, tying all the timber firmly together. The walls were of concrete strongly reinforced with 1¼-inch

*Condensed from a paper by Frederick W. Adgate, Chicago, Ill., before the Lake Superior Mining Institute.

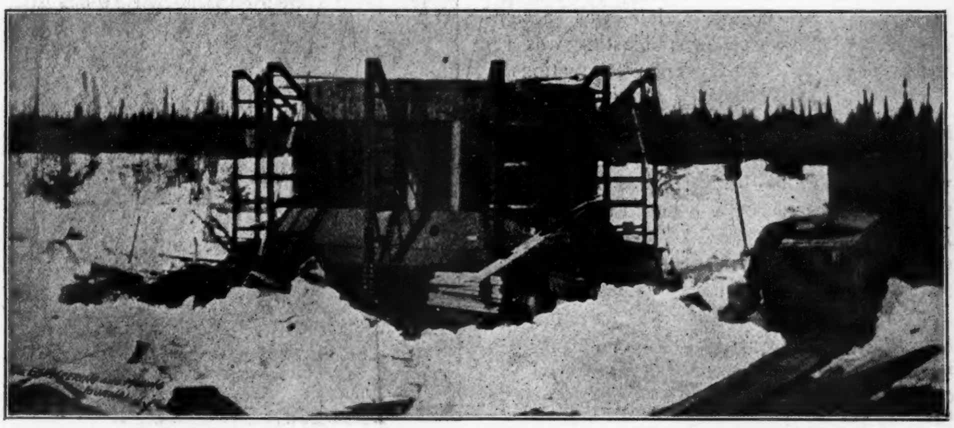
and 1-inch square steel bars spaced 6 inches to 8 inches vertically and about 18 inches horizontally. The horizontal reinforcement was designed to take the earth and water pressures, while the vertical rods mainly prevented the lower sections of the walls from pulling away from those above during sinking operations. These vertical rods passed down through the timber cutting edge, anchoring same to the concrete walls. Six feet above this cutting edge, and notched into the concrete wall, was the deck, or roof, of what is familiarly called the working chamber. It is of course necessary in using the pneumatic process to confine the air to make its use effective. This is accomplished in shaft work by building a roof or cover over the inside of the shaft, strong enough to withstand and hold any required air pressure. This roof, or deck, as it is technically called, may be located at a point near the bottom of the shaft or higher up as convenience may dictate.

After the shaft was on the ledge and a tight joint made with the ledge, the air pressure was removed, and then, owing to the manner in which the deck was notched into the walls, it was readily pulled out, and the notch concreted flush with the walls.

In the center of the shaft and bolted on to the upper side of the deck was the man-and-material shafting, which consisted of steel sections ½ in. × 48 in. diameter bolted together and supplied with vertical ladders bolted to the inside and extending from the deck to the surface of the ground. The 48-inch steel cylinder was surrounded by the Moran air lock, which was devised and patented by D. E. Moran, of the Foundation Company. A hole 3 feet in diameter was cut in the timber deck, which established a communication between the working chamber below the deck to the man-and-material shafting above the deck.

The cutting edge was first assembled at the surface of the ground and the inside forms for the first 10 feet built on top. All other forms were built apart from the shaft in sections 6 feet high and of interchangeable design. The form material was 2" × 8" tongued-and-grooved plank. After the forms had been placed and concreted to a height of about 18 feet, sinking without air was resorted to until water was encountered, at a depth of about 5 feet from the surface. Air was then pumped into the working chamber until the water had been displaced after which men were sent into the shaft, and excavating began. The material was shoveled into a bucket, hoisted up through the man-and-material shaft to the air lock; the contents dumped into small cars and removed some distance from the shaft where it was used to level up the ground. The bucket was returned to the working chamber for another load. On account of the slow-setting qualities of the cement, only one gang of men was required to excavate from 4 p. m to 12 o'clock midnight, in order to keep pace with the erection of the concrete which was carried on during the day.

To keep the shaft lining above the ground at least 18 feet all the time, required the use of three sets of concrete forms, the lower set being removed as it reached the ground, and



CIRCULAR CAISSON WITH CUTTING EDGE IN COURSE OF CONSTRUCTION.

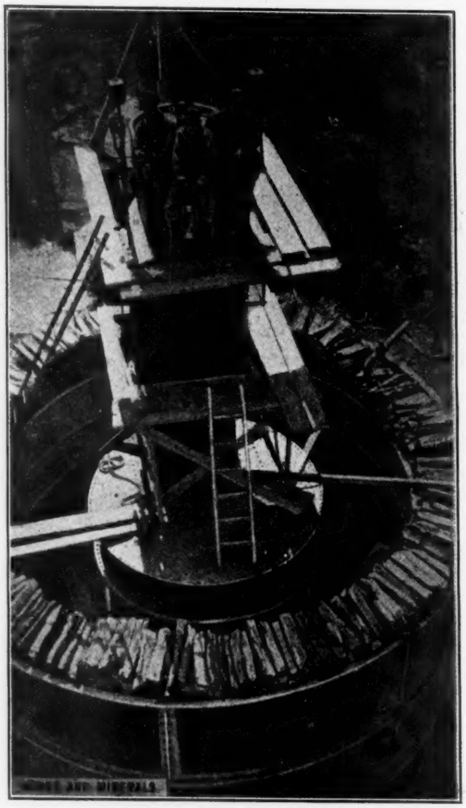
replaced at the top as the material was removed from the interior of the shaft and from under the cutting edge. The shaft sank of its own weight until it had reached a depth of approximately 40 feet when it became necessary to apply additional weight. The only available weight at that time was wet sand. This was loaded upon the deck in the interior of the shaft and increased from time to time. The shaft went down steadily until it reached solid rock on December 7, exactly 1 month from the time air was first applied. The rock was first encountered in one corner of the shaft and proved to have a slope of 3 feet 6 inches in 20 feet, and in order to make a water-tight joint, it was necessary to level off this rock and then go down about 2 feet further in order to get below a seam in the rock. The rock excavation was accomplished under air pressure; blasting was resorted to as in ordinary open excavations.

The rock excavation was completed January 5, 1908. The inside top timber comprising part of the cutting edge was then removed and the walls concreted to the rock, thus presenting a solid masonry face from ledge to surface. This joint was tied to the rock ledge with steel dowels and to the walls above by means of bolts projecting and which had previously held that part of the cutting edge which was removed and replaced by concrete. Air pressure was maintained on the shaft for 3 days after the completion of the joint to allow the concrete forming the joint ample time to set before subjecting it to the outside water pressure. The air pressure was then gradually reduced to zero. Subsequent inspections showed that the shaft developed a leakage of about 6 inches of water (650 gallons) in 24 hours, most of it coming through the rock ledge at the bottom, some little percolating along the wires in the walls above, which had been used to hold the concrete forms together. Absolutely no water, not even a seepage, was discernible through the joint. This was all that could be anticipated or hoped for, and I have since been informed that most of the leaks have dried up.

After sinking operations were completed, and the temporary weight of wet sand together with the deck was removed, holes were drilled into the walls and heavy cast-iron brackets bolted against the same. These brackets carry horizontal channel irons dividing the shaft into compartments for skips, cage, and a pipe and ladderway. It is further proposed to sheath these compartments with corrugated iron or similar fireproof material.

KIDDER SHAFT.

After the successful completion of the Smith shaft, the Cleveland-Cliffs Iron Co., entered into another contract with the Foundation Company to sink the Kidder shaft which is located in the same district. Here the conditions



TOP OF KIDDER SHAPE CAISSON.

are somewhat different. The general character of the overburden is the same, but deeper, and the foundation rock is more broken up and seamy. It was decided that a circular shaft was best adapted to this particular site.

Plans were accordingly drawn for a reinforced concrete structure of a circular cross-section, being 24 feet in outside diameter and having an inside diameter large enough to provide a rectangular space of 14 ft. 10 in. × 10 ft. 10 in. The walls of the shaft were built upon a steel shoe, 24 feet outside diame-

ter, where it was riveted to a steel cone plate on the inside, the slope of which extends up to a height of 10 feet, making the working chamber, or caisson, conical in shape and providing a circular opening at the top of the chamber, or cone, of a diameter of 10 feet, to the top of which are bolted steel sections of 10-foot diameter, which are carried up section by section as the structure sinks, and through which was operated a clam-shell dredge. This dredging cylinder also acted as a wall of the caisson while sinking operations were conducted by the pneumatic process.

The general plan of sinking the Kidder shaft was as follows: The shaft was erected some 15 feet in height and two sections of the dredging cylinder connected to the top of cone plates; a clam-shell dredge was then lowered through the 10-foot dredging shaft into the bottom where digging operations began. As the clam shell displaced the material, the shaft settled by its own weight. Care had to be taken to build on the top fast enough to always keep the top of the structure several feet above the surface. This plan of sinking was followed until the shaft had reached a depth of 87 feet below the surface, where a stratum of very hard clay was discovered which the dredge refused to handle. A steel deck or roof was then bolted on to the top of the dredging shaft. This deck in turn supported a Moran air lock and the shaft was now equipped for compressed-air operations which were immediately begun and the shaft carried down to the ledge which was found to be 104 feet from the surface. The ledge was so broken up and seamy that it was found necessary to take the shaft 9 feet into the ledge, making a total excavation of 113 feet from the bottom to the collar of the shaft, or 113 feet below water elevation.

The cutting edge or shoe, the inside of which forms the conical space at the bottom of the shaft, deserves further mention. It weighs approximately 40,000 pounds and is made in three horizontal sections, and each section is made up of 12 plates of ½-inch steel, joined to the succeeding section by a lap-riveted joint. On the outside of the bottom, there is a steel plate 30 inches high by ⅝ inch thick that forms the base of the cylinder and the outside form of the wall of the shaft to which the steel brackets and plates which form the cone are attached. The angle, or slope of the cone on the inside, with the outside of the shaft is made the shape of the brackets. This slope is the ratio of 7 to 10, or about 40 degrees, with the vertical or sides of the shaft. These brackets are riveted to the heavy outside plate and to all the plates forming the cone. There are 12 of these brackets and they are made in two parts bolted together, so that one part is readily detachable from that part of the steel work which necessarily remains in the concrete and forms part of the permanent wall. In the construction of the walls of the shaft, two sets of forms were used, one on the outside and one on the inside. The outside form is made of three sections 5 feet high and 24 feet in diameter. Each section is in turn made up of six plates of ½-inch steel bent to a 12-foot radius on the inside, on all four sides of these plates 4-inch angles are riveted to make the necessary connections of the several pieces to make the circle and also to connect the sections one to the other to make the wall continuous, proper bolt holes being punched at certain intervals in the angles to make this possible. The inside forms were also made in three sections, each section being constructed from 2 in. × 6 in. tongued-and-grooved pine held together by three sets of 4 in. × 4 in. × ½ in. angles bent to the radius that will give the necessary thickness of the wall at the various depths of the shaft.

The thickness of the walls of the shaft varies, of course, with the depth the shaft has to go and the pressures that will come on the wall. In the case of the Kidder shaft, the wall at the top is 2 feet thick, down to a depth of 17 feet. It is there increased to a 2′ 6″ wall, to a depth of 50 feet, then increased to a 3-foot wall at this point and carried to a depth of 82 feet and is there increased to a 3′ 6″ wall and carried with that thickness to the bottom, 113 feet below the surface.

In order to sink the Kidder shaft to the depth it finally went, it was necessary to use 375 tons of pig iron in order to overcome the excess of friction encountered and the upward pressure of the compressed air over and above the weight of the structure itself.

At a point 87 feet below the surface, a very hard stratum of clay some 2 feet thick was discovered. After dredging some hours without much success the clay was penetrated at one point only and the quicksand which underlies the stratum of clay started to run into

the interior of the shaft, causing a run-in or slump of the ground on the outside of the shaft at one point only, which extended to the surface and threw the shaft some 6 inches out of plumb. Dredging was then abandoned and the shaft equipped to carry on further sinking operations by the pneumatic process. This method was used until the completion of the shaft. When the shaft had been sunk into the ledge some 9 feet a concrete joint was constructed similar to that described in the Smith shaft.

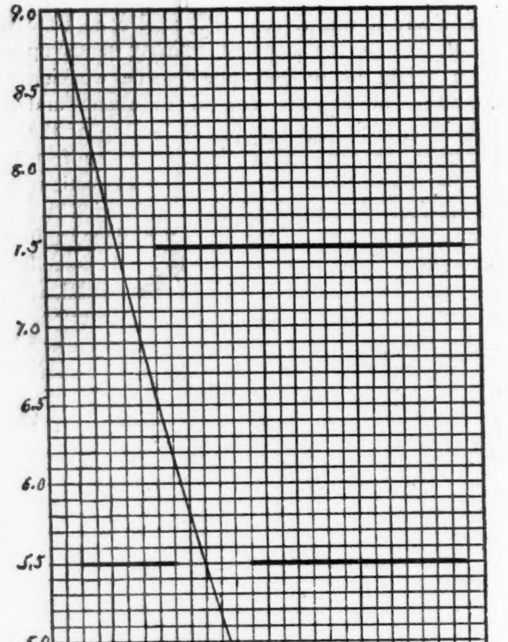
The maximum air pressure used on the Kidder shaft was 45 pounds above atmosphere. This is about the limit of human endurance and very dangerous to the men employed inside the shaft. At the greatest depth two shifts of 40 minutes each constituted a day's work, and while no fatal effects followed, three of the men are to-day suffering from partial paralysis and will never wholly recover from its effects.

MEAN EFFECTIVE PRESSURE IN AIR COMPRESSION

We reproduce on the opposite page, from a recent issue of the American Machinist, a diagram which, under all conditions which occur in the adibatic compression of air affords the simplest means yet devised, or we might say, likely to be devised, for ascertaining the mean effective pressure in the cylinder for the entire operation, and from that, of course, also the horse power. The diagram was calculated and plotted by Mr. Ward Raymond, assistant chief engineer at the Phillipsburg plant of the Ingersoll-Rand Company.

The diagram is, of course, immediately and clearly intelligible to the trained engineer and to the well informed student, but we think that a word or two of explanation more than was given with the original publication of the diagram may make it available to a still larger number who are normally more expert in other lines.

The four curves of the diagram are, in fact, four separate portions of a single curve brought together upon a single sheet for compactness in publication rather than for convenience in use. The entire curve is shown on a much smaller scale in Fig. 1. The section lines in this cut correspond to the larger section lines only of the other diagram. In this cut all the figures indicating the lines are in

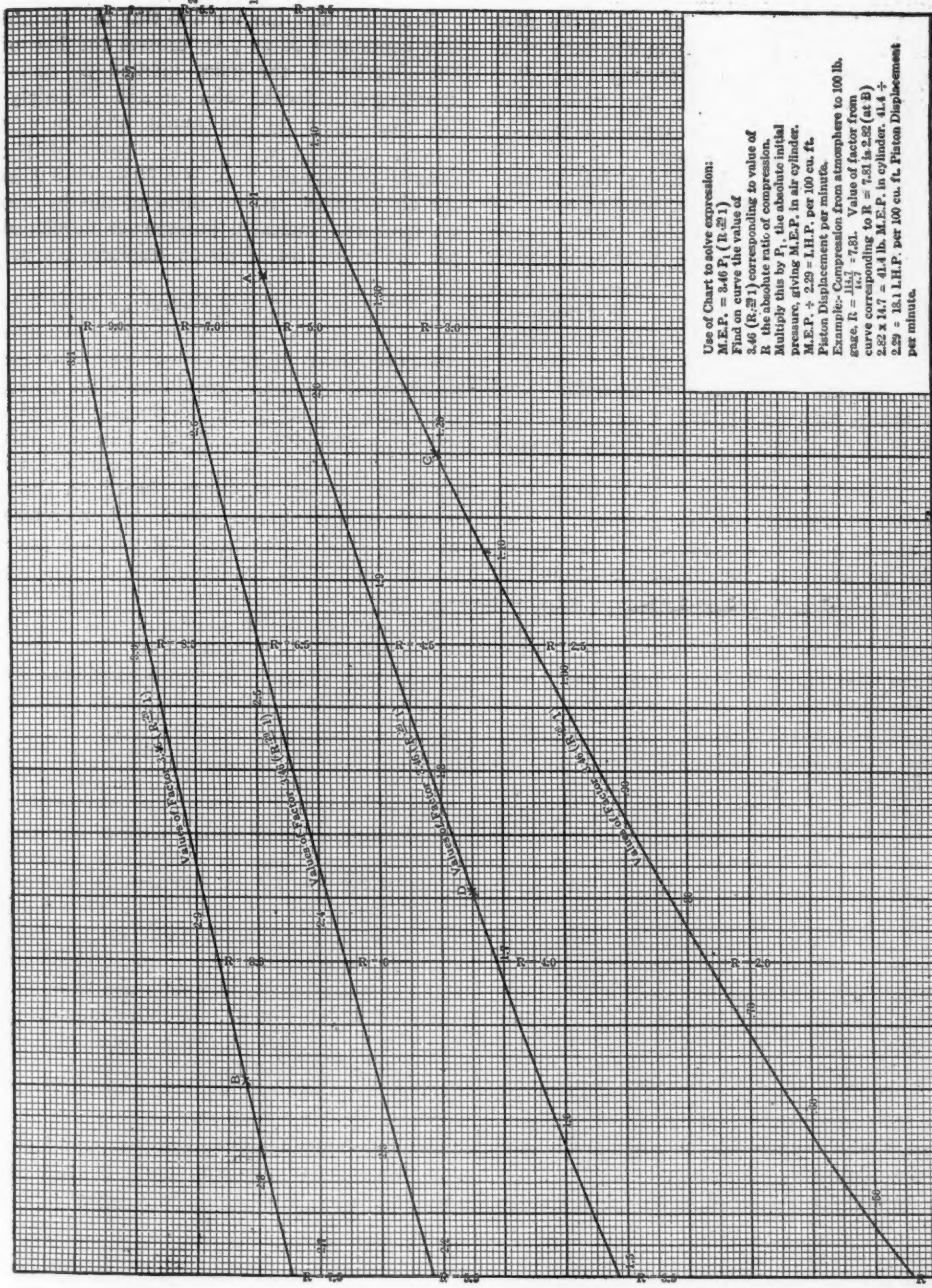


THE ENTIRE CURVE.

regular sequence. In the large diagram the figures belong only to the curve nearest which they are located, and do not apply in any way to more than the one curve.

The diagram embodies the solution of the expression:

$$M\,E\,P = 3.46\,P_1\,(R^{0.29} - 1).$$



WARD RAYMOND'S CHART FOR DERIVING MEAN EFFECTIVE PRESSURES FOR ADIABATIC COMPRESSION OF AIR FROM ANY INTAKE PRESSURE

MEP refers to mean effective pressure developed in the air cylinder; P_1 is the absolute initial pressure, which in the case of an air compressor is usually atmospheric; R is the ratio of compression, or the absolute discharge pressure divided by the absolute initial pressure. Knowing the value of R from the conditions of the problem, we find directly from the diagram the corresponding value of the rest of the expression, namely, 3.46 $(R^{0.29} - 1)$, and multiplying this factor by the absolute initial pressure, gives at once the mean effective pressure. The four following examples will serve to show the simplicity of the operation:

1. Assume single-stage compression from the atmosphere to 60 pounds gage pressure. R, the ratio of compression, will be $(60 + 14.7) \div 14.7$, or $74.7 \div 14.7 = 5.08$. Examining the diagram we find that the vertical line marked A contains the value of $R = 5.08$. From the curve at this point we find that the value of the factor for which we are looking is 2.082. In the case of this problem the initial pressure is atmospheric, or 14.7 pounds per square inch absolute. Multiplying 2.082 by 14.7 we have a mean effective pressure developed in the air-compressor cylinder of 30.6 pounds per square inch, based on adiabatic compression. This is the true theoretical adiabatic *MEP* exerted against the piston and it is not necessary to deduct the back pressure from this as in the case of the usual steam formula.

In most compressed-air problems the mean effective pressure is not wanted so often as the indicated horsepower per 100 cubic feet piston displacement per minute, and in all cases this can be found by dividing the mean effective pressure by 2.29. For the case in point, dividing 30.6 by 2.29, we have 13.4 indicated horsepower developed in the air cylinder per 100 cubic feet of piston displacement per minute. Dividing this by 100 and multiplying by the piston displacement per minute of the compressor, we have the total indicated horsepower in the air cylinder in question.

Say that the compressor cylinder was 24 in. diameter by 30 in. stroke at 60 revolutions per minute; then the free air capacity would be:

$24^2 + 7854 + 5 + 60 \div 144 = 942$ cu. ft. per min. Then $9.42 \times 13.4 = 126$ theoretical horsepower.

2. If the compression were single-stage from atmosphere to 100 pounds the value of R would be

$$114.7 \div 14.7 = 7.81.$$

From the diagram we find that the vertical line containing $R = 7.81$, crosses the line of the diagram at the point marked B, corresponding to a factor value of 2.82. Multiplying this factor by the initial pressure 14.7 pounds, absolute, we have an answer of 41.4 pounds per square inch *MEP* developed in the air cylinder. Again, dividing this by 2.29 we have 18.1 indicated horsepower developed per 100 cubic feet of piston displacement per minute.

3. For compound compression we have only to remember that with theoretical conditions the horsepower of the low-pressure and the high-pressure cylinders should be alike, giving the minimum total power developed. In practice air compressors are designed so that this is approximately true. The curves and all the formulas are, of course, based on theoretical adiabatic compression, and therefore we are correct in assuming that the horsepowers in each of the two stages of compression are equal. If the horsepowers are equal this means that the ratios of compression in the two stages also are equal, and consequently the ratio of compression in each cylinder for compound compression will be the square root of the total ratio of compression.

From atmosphere to 100 pounds pressure we have already found that the total ratio of compression is 7.81. The square root of this, or the ratio of compression in either the low-pressure or the high-pressure cylinder, is 2.8. Entering the diagram we find that the line corresponding to the value of $R = 2.8$ crosses the factor line in the diagram at the point marked C and corresponds to the value of the factor 1.204. Multiplying 1.204 by the initial pressure 14.7, we have the mean effective pressure in the low-pressure cylinder 17.7 pounds per square inch. Dividing 17.7 by 2.29, we have the power in the low-pressure cylinder, 7.73 indicated horsepower per 100 cubic feet of displacement of this low-pressure cylinder. As this must be half of the total compressor horsepower of the compound compression, we have 15.46 indicated horsepower total for the two stages per 100 cubic feet of displacement per minute. Dividing this by 100 and multiplying by the low-pressure cylinder displacement in cubic feet per minute we would have the total indicated horsepower of the compressor in question.

This process may be carried through three,

four, five or any number of stages of compression. All that needs to be remembered is that for multiple-stage compression the horsepower in all the cylinders is supposed to be equal; therefore finding the horsepower in the low-pressure cylinder we can multiply this by the number of stages or cylinders, giving us the total horsepower of the compressor. In order that the horsepowers shall be equal, the ratios of compression in the various stages must be equal and consequently for compound compression, must be equal to the square root; for three-stage the cube root and for four-stage the fourth root of the total ratio of compression.

4. Assume three-stage compression to 1000 pounds pressure. The value of R, the ratio of compression, will be 1014.7 divided by 14.7 or 69.2 compressions. With equal horsepower in each stage the ratio of compression in each stage and consequently in the low-pressure cylinder, will be the cube root of 69.2, or 4.11, and in the diagram we have the value of 4.11 for R marked D. For this value of R the diagram gives us the factor 1.75. Multiplying 1.75 by 14.7 we have 25.7 pounds per square inch mean effective pressure in the low-pressure cylinder. Dividing this by 2.29 we have 11.22 indicated horsepower per 100 cubic feet per minute displacement of the low-pressure cylinder.

This is the horsepower in the first stage, also in each of the succeeding stages; consequently multiplying this figure by the number of stages, namely, three, we have a total horsepower for the compressor of 33.7 indicated horsepower per 100 cubic feet piston displacement of the low-pressure cylinder of the compressor per minute. This divided by 100 and multiplied by the piston displacement of the low-pressure cylinder per minute will give the total theoretical horsepower of the compressor.

METHANE FROM COAL SEAMS AS FUEL

Information respecting a very interesting utilization of the dreaded explosive hydrocarbon of coal seams, methane CH_4, has recently become available from the Frankenholz Colliery of the Frankenholz Bergwerks-Gesellschaft, near Mittelbesebach, in Rhenish Bavaria. The mine has a depth of 500 metres, and before attacking the coal seam at that level it was deemed advisable to bore to a depth of 50 metres in order to see whether much gas might have to be dealt with. When this was done a great deal of gas escaped under considerable pressure, and a pipe-line of 1,500 metres length (nearly 1 mile) was taken up to the surface. This was in February, last year. As the pressure of the gas was still 12 atmospheres in June, 1908, the Dingler Maschinenfabrik A. G., of Zweibrücken, was asked to fit the Lancashire boilers of the colliery for burning this methane. In order not to waste any of the heating surface of the two internal furnaces, and to secure a complete combustion of the methane, the following arrangement has been adopted.

Two combustion chambers, consisting of two cylinders placed alongside one another, have been constructed in front of the boiler, each chamber communicating through a neck of smaller diameter than the combustion chamber with the internal furnace. The gas is introduced through the front of the cylinder by a central pipe, inside which a small air-pipe has been provided. The main air feed is, however, through a crescent-shaped inlet, closed by an adjustable slide. The front of the chamber is further fitted with a door; through this door a torch is introduced before the gas admission valve is opened, lest any explosive mixture collect in the internal furnace. The combustion chambers are built of firebrick, and a layer of asbestos is interposed between the outside of the firebrick and the cylindrical iron shell. The gas is very fairly pure methane, containing about 8 per cent. of nitrogen, traces of oxygen, and some water vapor. As far as possible this vapor is condensed in the pipe-line of 6 1-2 in. internal diameter, which is for this purpose provided with cylindrical condensers. Two methane boreholes supply sufficient gas for two boilers, each of 700 square feet heating surface, and 40 kilogrammes of steam are produced per square centimetre of heating surface per hour (about 9 lb. per square foot.) The temperature of the flue gases leaving the boiler furnace does not exceed 280 deg. Cent. (530 deg. Fahr.) We have not yet received any exact determination of the gas consumption; but it is estimated that the methane burned is calorically equivalent to about 16 tons of average quality coal per 24 hours. We understand that it is intended to resort to further boring, with the object both of increasing the safety of the

mine and of utilising the methane gas. In several of our mines the escaping methane is used for illumination; but we are not aware of any case of burning the gas for the purpose of generating steam.

HOMEMADE PRESSURE REGULATOR

The pressure regulator described herewith was designed to regulate a compressed-air oiling system, but by using heavy glass and brass connections the instrument can be used on higher pressures.

The regulator consists of a U-shaped glass tube 1/8 inch in diameter. Glass cups are fitted on the ends, as shown. As fusing a wire into a glass tube requires platinum wire and, no little patience, I made the cup connections very secure with corks and wax, as the drawing shows. This makes the ends the strongest part of the cups. Two No. 20 rubber-insulated copper wires are inserted through holes in the cups, and sealed in after being adjusted to the desired pressure and cut to the same length. Each wire must be scraped bright 1/8 inch on the end.

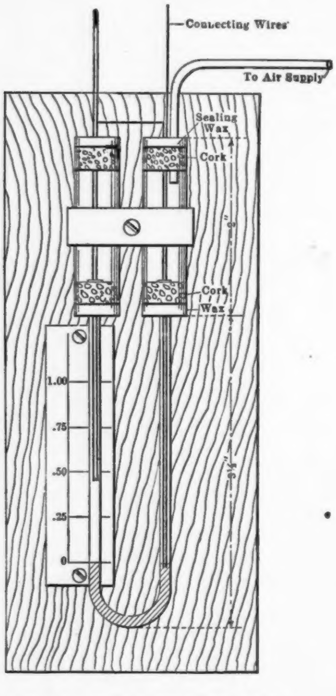


FIG. 1. PRESSURE REGULATOR.

A brass tube also enters the top of the right-hand cup and is connected to the air space in the oil reservoir. In the regulator which I made, a valve was placed just above the cup, a nipple connecting the cup and valve.

Fig. 2 shows the electrical connections, which run to a solenoid *O*. The solenoid was taken from an old arc lamp, and has considerable lifting power. If the screw on the back of the stop cock *S* is loosened and the valve well oiled, no trouble will be experienced in making the solenoid operate the cock. A trip magnet *M* allows the arm *A* to fall and cut off the air supply when the circuit at the regulator is closed.

A glance at the diagram will show the principle of operation; a rise of pressure above a certain value forces the mercury up in the left-hand tube, closing the circuit *X* and shutting off the air supply. A drop in pressure will cause circuit Y to energize the solenoid, opening the air valve. A little oil on the mercury surfaces will prevent sparking.

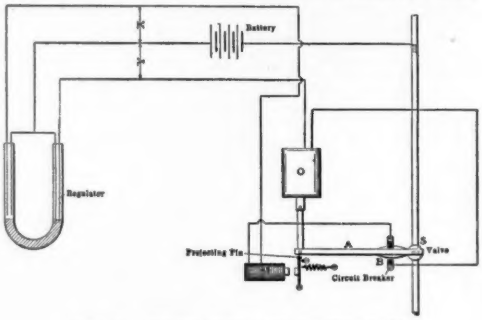


FIG. 2. REGULATOR AND CONNECTIONS.

On high pressures the left-hand cup must be sealed at the top; on low pressures the top may be left open and the scale calibrated as follows: Open both ends of the tube to the atmosphere and, taking the mercury level as zero, make divisions 1 inch apart; each division then represents approximately 1 pound per square inch. For feet of water the divisions should be 7/16 inch apart, each division representing 1 foot of water.

The easiest way to make a cut-out switch that will open the circuit as soon as the valve changes is to fasten a blade of copper *B* to the arm *A*. Then the current cannot be restored until contact is made on the opposite side.

In case the apparatus is used for a water-tank regulator, the scale divisions may be made 4/5 inch apart, each division representing one foot of water. For this use it is bet-

ter to make the U-tube 18 inches or more in length.—*R. S. Seese in Power and the Engineer.*

HUMID AIR TROUBLE IN A STEAM HEATING SYSTEM

BY A. J. DIXON.

The heating system in a populously tenanted public building had become an unremitting source of exasperation, alike to those occupying quarters in the building and to the engineer and attendants in charge of the apparatus, on account of its ever-present propensity to get out of order and refuse to properly perform its function in a dozen or more different and widely separated places at the same time. A prominent feature of this heating outfit comprised an equipment of thermostats for automatically regulating the

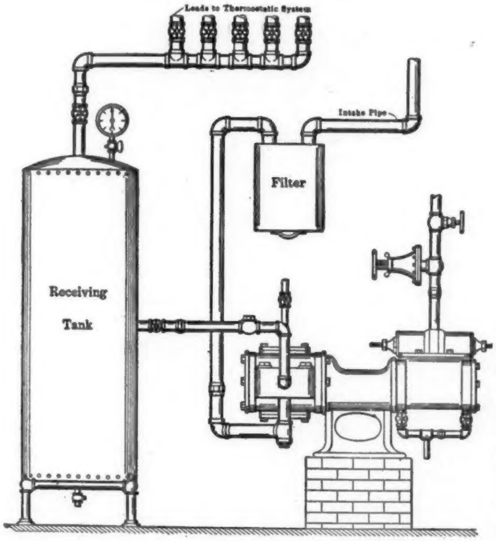


FIG. 1.

admission of steam to the various radiators and heating coils, the controlling medium being air compressed to about 15 pounds gage per square inch. The admission of this compressed air to impingement upon the diaphragms by which the steam valves were actuated, and its release therefrom, was controlled by somewhat complicated mechanism under the immediate influence of the theromostats, and to the everlasting proneness of these contrivances to become inoperative, by reason of the moisture in the saturated air fouling and obstructing the minute ports and passages therein, was generally due the failure of the heating apparatus.

The equipment for compressing and storing the air, and its manner of distribution, as planned in the original imstallation, is shown in Fig. 1. The presence of an excessive quantity of moisture in the air flowing through the five leads to the various branches of the

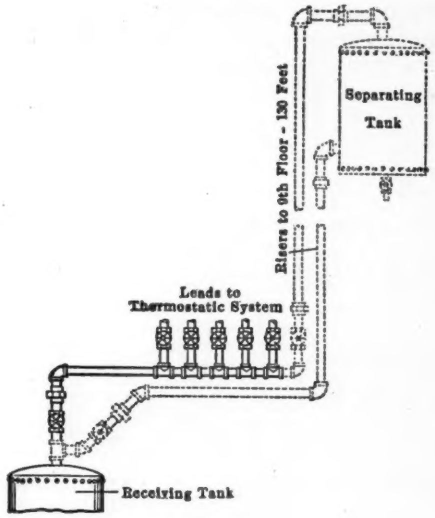
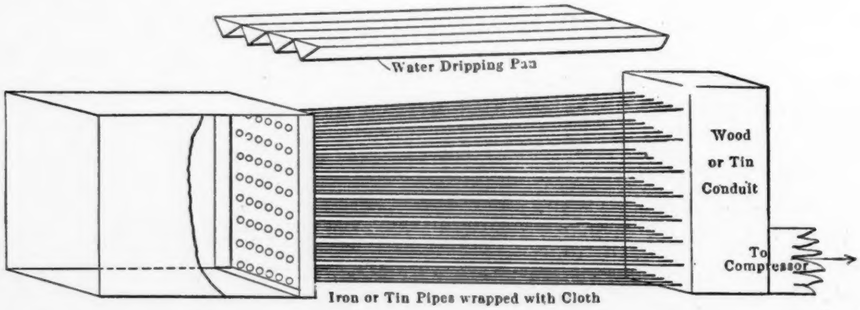


FIG. 2.

system furnished ample evidence of the fact that but a very small percentage of the water, with which the air passing through the intake pipe was laden, was being precipitated in the receiving tank, and likewise made it plainly apparent that a more adequate means for disposing of this moisture would have to be provided before the thermostatic system could be depended upon to properly regulate the temperature of the building. The engineer in charge of the plant, therefore, cast about for an available method for improving the situation, and after pondering various schemes that were advanced, he finally hit upon the device illustrated in Fig. 2.

A tee was inserted in the short riser from the main reservoir, and a 1½-inch branch and riser was carried therefrom to a vertical hight of 130 feet, where it connected with a precipitating tank located upon one of the upper floors. The object aimed at in conveying the air to this hight above the plane of distribu-

tion was to provide ample opportunity for the entrained moisture to separate by gravitation from the column of air in its ascension through the long vertical passage, the supposition being that the precipitation produced in this manner, combined with the final separation effected in the upper tank, would result in eliminating the water vapor to such an extent as to provide a practically dry supply of air. Subsequent events proved this surmise to be eminently correct, for after the installation of the contrivance shown in the sketch no further trouble was experienced.—*Power and the Engineer.*



AN AIR COMPRESSOR PRECOOLER

It is, of course, well understood that when a certain weight or quantity of air is to be compressed any reduction of its volume by the lowering of its temperature before it enters the compressor cylinder effects a saving in direct proportion. Wherever it is possible to materially reduce the temperature of the intake air it can usually be done without appreciable cost beyond the installation of the cooling apparatus, and the economical results secured come as near to the getting of something for nothing as can be expected in mechanical practice.

The sketch which we here reproduce from a recent issue of the Engineering and Mining Journal, shows a precooler arrangement which should be effective and satisfactory where it can be employed. The cooling tubes, as they are not subjected to pressure either external or internal, and as the thinner they are the better, may be made of any odd sizes of iron, or even tin or galvanized iron speaking tubes may be used. These should be wrapped with thin cloths and perforations in the water dripping pan above should be sufficient to keep the cloths constantly wet. There should be no enclosure and no obstruction to a free circulation of air, and if winds or drafts can be enticed to play upon the tubes, so much the better.

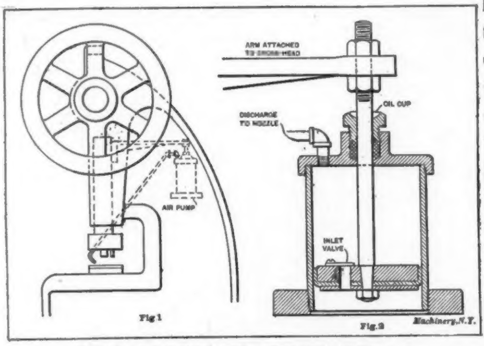
It is suggested, as bearing upon the practical value of precooling, that at a large plant in California the difference between the temperatures of wet and dry thermometers in summer has reached 40 degrees, or between 110 and 70, this being in absolute temperatures, and consequently in air volumes nearly 8 per cent. cent.

In the remarks of our contemporary in connection with the present precooler, it is said: "It is to be emphasized in the beginning that water or moist air should have no chance to mix with the compressor suction. . . . The arrangement shown in the sketch precludes the saturation of the air with water, as recently complained of in South Africa, where precooling by spraying water directly into the intake was attempted. In fact, if the temperature of the water supply is below the dew point, and an abundance is available, water will actually be condensed out of the air as drawn to the compressor, and can be drawn off from the bottom of the cool air conduit."

This means, of course, that the air cooled without contact with water may be and often is completely saturated with moisture as it enters the compressor, so that it may be unobjectionable and often good practice to wash and cool the air by water in intimate contact with it. As air after compression and recooling to normal temperature is practically always supersaturated with moisture, it is futile to attempt to get or to keep the air "dry" before the compression.

A PRESS DOES ITS OWN BLOWING

In our October issue, page 5436, we reproduced a cut from *Machinery* showing how the shop air pressure was employed to blow small pieces of work from a forming die in a punch press. The cut here shown, from the same publication, tells very clearly how another punch was equipped with a compressor or



WORK BLOWER FOR PUNCH PRESS.

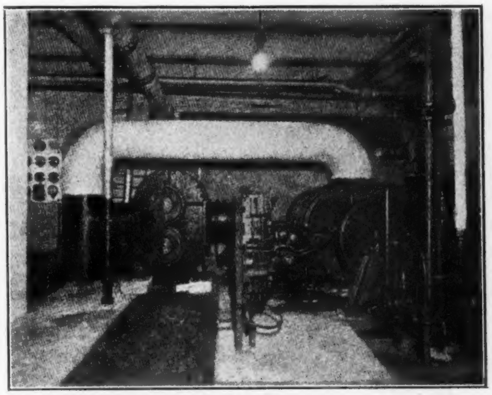
pump of its own. The piston rod of this pump is connected directly to the crosshead of the press. The air is compressed on the up stroke, and it is delivered against the work by means of ⅛-inch pipe which is fitted on the end with a nozzle. The pump cylinder is made of a piece of 3-inch brass tubing which is screwed into a base-plate, as shown in the enlarged sectional view, Fig. 2. This tubing is fitted with a head containing a stuffing box, and ⅛-inch pipe outlet. The piston is a regular 3-inch hydraulic cup, and a piece of leather belting is used as packing. A piece of leather fastened by one screw to the inside of the piston, covers a ⅜-inch hole and acts as an inlet valve. The finished work has an upturned portion on the front end, and the nozzle is placed so as to direct the blast against this point.

A DEPARTMENT STORE PNEUMATIC CASH SYSTEM

An interesting pneumatic cash system has recently been placed in operation in a large department store at Pittsburg. There is approximately seven acres of floor space and over three miles of cash tubing is in use. Change is made in an average time, for all stations, of from one to two minutes.

The system, which was installed by the Lamson Consolidated Store Service Company, is know as an independent vacuum pneumatic-tube system. There are eighty-four lines in operation, seventy-three of which are for cash and the remaining seven take care of the charges.

The cash office, is located in the basement, under about the center of the building. From eighteen to twenty-four cashiers, of whom four or five are at the charge desks, are employed to handle the business. Each cashier operates from five to seven lines, a space of about twelve inches separating the banks of tubes assigned the operators. The charge desks are located in the center of the cash office. The charge lines, or tubes, branch off from here to the various points, so located that there is one charge station between every two cashiers. This arrangement brings the regular cashier into close touch with those who enter the charges. The charge desks are also connected by tubes with the general offices on the fifth and the credit office on the first floor. Each of the eighty-

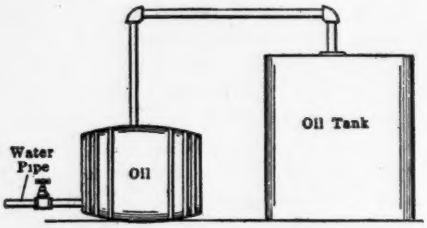


BLOWERS FOR CASH SYSTEM.

four salesmen's stations uses, on an average, six cash and four charge carriers.

The power to operate this system is furnished by two Root Blowers, chain driven, by Western Electric fifty and fifty-five horse-power motors. The blower shown at the right in the accompanying illustration (from *Electrical Review and Western Electrician*) is the larger of the two. The plant includes also a vacuum cleaning system, a twenty ton refrigerating equipment and thirty-eight motors of various sizes. There is a special motor driven compressor which furnishes air to a stop-

cock and hose outside. Where automobile owners may pump up their tires—without the pumping.



WATER INSTEAD OF AIR FOR TRANSFERRING OIL

Our readers are sufficiently familiar with the use of compressed air for forcing liquids as in the emptying of oil barrels. The sketch by a correspondent of Power and the Engineer shows how water may sometimes be employed to advantage for this service. Connect a pipe into one head of the barrel near the lower edge, and another leading from the bung to the oil tank as shown. Then put the city water pressure on the pipe in the head which will force the oil into the tank. The oil, being lighter than the water, will keep on top until the last drop of it is forced out. The connections must, of course, be tight, although the pressure will not be great. This is after all not nearly as good as a compressed air apparatus, because it will not be easy to determine precisely when the oil is all out to stop the flow of water into the tank, and then also there will be the barrel of water to be disposed of.

A FOUNDRY PATTERN EXPLODES

Stahl and Eisen, in a recent issue describes an unusual, if not unheard of, accident. A large engine bed, molded in the floor, was being cast. The mold had been dried by torches. Its cores were vented upward, except those of the shaft bearing, whose vents were lateral. In addition, deep vent-holes had been pricked in the sand all around the periphery of the mold at short intervals, say, 4 ins. apart. Alongside this mold and about 5 ft. away, a second mold of this frame was in preparation, and the pattern was in the sand with no cope on it at the time. This pattern was substantially a long, hollow box, closed on all sides, about 22 ft. long by 2½ ft. wide and 4 ft. deep. About three hours after the finished mold was poured, some men were at work nearby filling a ladle with molten iron, and a drop of the iron was spattered out upon the top of the frame pattern lying in the unfinished mold. The pattern blew up violently, injuring five men, one fatally, damaging the roof and breaking most of the windows of the foundry. It seems that the venting of the frame mold had not been sufficient to carry all the gases off freely, and enough filtered through to the adjoining unfinished mold and through the joints of the pattern to fill its hollow interior with an explosive mixture. The same frame had been cast several times previously without accident, but after the explosion the top face of the pattern was provided with several large holes, to make impossible any accumulation of gas inside.

THE ITALIAN WIRE SAW FOR STONE

The elder Corsi, whose surname is Adolfo, is the marble magnate of Italy. The younger Corsi has recently visited the United States. The following is his account, from a reported interview in the New York *Sun,* of the Italian wire saw:

"The cutting machine invented by our engineers has revolutionized the marble industry of Italy. We have done away with the use of dynamite. The machine is simple, consisting of a cable about the size of a pencil which is composed of three strands and drums, which, of course, have to be operated by an engine. The cable, which acts as a saw, is kept running in one direction, its work being helped with applications of sand and water. For a length of a hundred feet it will cut six inches in an hour. All this work we used to do in Italy by hand. With the aid of the machine we have done work in the mountains within one week that used to take us two or three years. We once took out a block by this method that measured 250,000 cubic feet."

He further says, and we are not inclined to accept his dictum, that "We cannot use derricks in our quarries. We have to break up our undesirable stone as we go along and remove it by hand, consequently we are having frequent powder blasts, and derrick machinery would not stand a bombardment of rocks."

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EVERYTHING PNEUMATIC

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UNCOMPARABLE RECORDS

In the race of life the pacemaker is always, though often unknowingly, an essential agent of progress. It helps and stimulates us to know not only what others have done and how they have done it, but also their rate of accomplishment. In any industrial operations, especially where, as always, speed and cheapness are to be considered, the record of the latest work done must be certainly not behind and should be in advance of all which has been done before. The making of records is not to be recognized as such except at it is also the breaking of records.

It is unfortunate, but still not infrequent, that records made are not properly or fairly comparable with those made by predecessors, or even by contemporary competitors, because the conditions of working are not the same in the different cases. In our present issue is an instance of the perfectly comparable record, in the performance of the locomotive rock drill as compared with the work of the tripod mounted, hand manipulated drills which it superseded, doing precisely the same class of work in identical material. So in driving a tunnel, if certain drills and mountings and methods of handling the material accomplished results which were accurately measured and recorded as to the quantity of rock removed or the lineal advance made in a given time, and if these drills and mountings with the system followed in the various correlated operations were so changed or modified as to show in the same tunnel and the same rock a much more rapid advance, then the work of the latter would be fairly demonstrated as superior. But this seldom or never happens. We have been making world records in tunnel driving in the past year or two and each successive increase in the figures has been widely and boastfully published, but unfortunately these have been made in different tunnels continents apart and with no reference to the kind of rock, the size of the tunnel, the personnel of the operating force, or any other responsible particular.

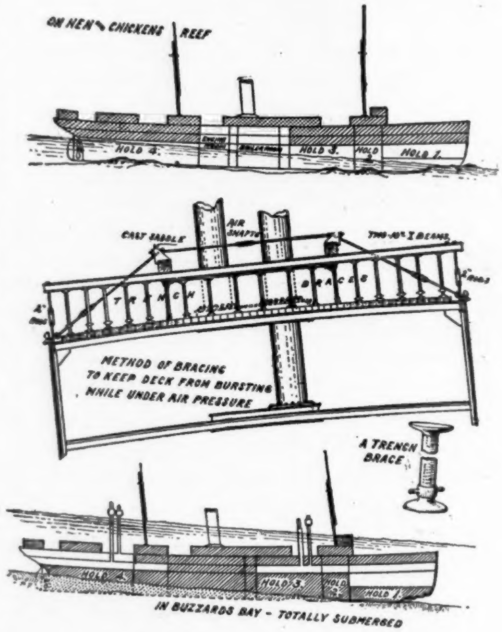
It is sufficient here to speak of only two now familiar tunnel driving records. The driving of the Loetschberg tunnel in Switzerland was described in our issue of February, 1909, page 5063. In this tunnel a record run of 1013 feet was made for the month of July, 1909. Reference to this is made by an esteemed contemporary in announcing "A World's Record in

Tunnel Driving" as having been made on the tunnel of the Los Angeles (Cal.) aqueduct in the 31 days of August, 1909, when an advance of 1061.6 feet was recorded. It is only necessary to say that the Loetschberg tunnel is driven in hard, solid rock requiring the most strenuous and constant pounding of the air operated rock drill and that the sectional area of the tunnel—for a two track railway—is 66 square yards. The section of the Los Angeles aqueduct is not more than one quarter of this and the material through which the record drive was made can scarcely be called rock at all. We are told that the drilling was all done by "hand drills," but these were not, as generally understood, air operated drills manipulated by hand, but simply coal augers worked by hand and run into the "rock" to depths up to 12 feet. Even the usual devices for ventilating the tunnel were not required, as this was taken care of by driving holes up through the roof of the tunnel to the surface, which was only about 75 feet. The absurdity of comparing this work with that of the Loetschberg tunnel is sufficiently evident, and if the record had doubled that of the Alpine tunnel it should not have surprised any one sufficiently informed as to the facts.

AN UNFORTUNATE YANKEE

In our issue of a year ago we briefly noted "The Ups and Downs of the Yankee." This U. S. auxiliary cruiser in September, 1908, was run upon Hen and Chickens Reef at the entrance to Buzzard's Bay, Mass., her position being indicated by the upper of the sketches here reproduced from the Scientific American. The bottom was pierced and torn in several places so that pumps were useless and a contract was awarded to Mr. John G. Arbuckle to raise her by means of compressed air. As in this case the vessel was not all under water, it was possible to place the necessary apparatus upon the vessel. The berth deck was made watertight and the water was driven down and out of holds 1, 2, 3 and 4 by compressed air, while the engine and boiler rooms were pumped out. The ship was floated by these means on December 4th, and was being towed to New Bedford when a tug struck her, damaging particularly the compartment containing the compressors, so that they could not be kept running and the vessel slowly sank in the position shown in the lower figure of the sketch. The bow of the vessel was a few feet below the water, but the stern lay thirty feet below the surface.

In the new salvage operations, divers being necessary all through, it was decided to leave the lower holds, the engine and boiler rooms, and the greater part of the gun deck full of water, and to lift the ship by expelling the water from the upper portion of hold No. 1, from the whole of the berth deck, and from the



SUBMERGED POSITIONS OF THE YANKEE.

after portion of the gun deck. Reference to the cut will explain the conditions of flotation, the unwatered areas being shown in white. The first step was to make special steel hatches, fasten them securely in place and calk them thoroughly watertight. The gun deck being of steel, was sufficiently watertight in itself, but the after portion of the spar deck, being of wood and having comparatively little resisting strength against the upward pressure of the air, it became necessary to reinforce it strongly. This was done by placing above the spar deck and upon the deck house a series of 10-inch I beams arranged in pairs, which extended the full width of the vessel. At its outer ends each pair of beams was anchored down to the waterway at the side of the ship by 2-inch

iron rods set up with turnbuckles. Upon the beams, immediately over the side walls of the deck house, two 12 x 12 timbers were placed parallel with the axis of the ship. Upon the outer edges of these beams were set special cast-iron angle blocks, which were tied together with 2½-inch rods. From each angle block on each side of the deck house a pair of 1½-inch truss rods was carried down and made fast to eyebolts which passed through the side plating of the ship and were held in place by nuts. Between the under side of the I beam and the spar deck were placed a number of trench braces, which were set up until they bore snugly against the spar, thereby serving to transfer the upward pressure of the air to the system of trussed I beams as above described.

The special steel hatches were provided with openings to which were coupled five large steel airshafts, which extended above the surface of the water and were provided at their upper ends with air locks. The wrecking plant consists of a large schooner, which is fitted up with living accommodations for the men; a big wrecking steamer, upon which is installed a compressor plant capable of delivering 5,000 cubic feet of free air per minute; a number of ship's boats, and a steam tug which makes regular trips between New Bedford and the scene of the wreck, two miles out in Buzzard's Bay. The difficulties of the work were greatly enhanced by the exposed position of the wreck, and there were many days when it was impossible to do any work.

These remarkable salvage operatives made excellent progress. The sections of the ship to be unwatered having been made airtight, and the truss bridging over the spar deck completed, a favorable conjunction of wind and tide concurring, the compressed air occupied its allotted spaces and the Yankee rose to the surface almost exactly a year later than her previous flotation, and compressed air had its triumph.

It is sad to have to record that the triumph was a brief one. An insufficiently braced bulkhead gave way so that the compressed air was not retained, and the Yankee sank again almost immediately, and all hope of raising her again was abandoned. The latest advices are that another attempt is to be made.

NEW BOOK

Through the Yukon and Alaska, by T. A. Rickard, Associate of the Royal School of Mines; Editor of Mining and Scientific Press and Mining Magazine; formerly State Geologist of Colorado. San Francisco, Mining and Scientific Press, 1909. Price, $2.50.

This is a book of 400 pages uniform in size with the Transactions of the Societies. It has 160 fine half tones from excellent photos, all pertinent to the matter and contributing to the interest of the publication as a whole. The book is full of just the right kind of information. It is also of high literary quality and is an unusually readable book for the general public.

AIR HAMMER DRILLS

At present air-hammer drills are being tried all over the country and in most camps they are being accepted as the only machine for drilling in raises, even in hard ground. In stoping the use of the air-hammer drill is confined to upholes in mediumly hard ground. Still in Butte the air-hammer drill has been used in stopes of first-class ore where much of the ore was in bands of chalcocite and enargite, with fair success— anyway at a lower cost than the two-men piston machines.

The air-hammer drill has only been adapted as yet to drilling "uppers" in which the drillings run out by gravity from the holes. The limiting angle is about twenty degrees when ribbed steel is used; as the rotation of the steel helps convey the drillings down the inclined sides of the hole. On this account ribbed steel should be used rather than hexagonal or round steel, especially as both these require shanking before use. Apparently hollow steel finds no favor in drilling uppers.

Some attempts have been made to adapt the air-hammer drill to drifting by using a hollow steel and injecting water or air into the hole through the steel. The great advancement in the near future will be in perfecting the air-hammer drill for sinking work. In medium hard rock they they have been used with some success already. Their great advantage is that the air-hammer drill does not require a large amount of space for its operation and that only one man is required to run it. So as soon as one end of the shaft is cleaned drilling can be-

gin as is the case with hand sinking. This saves lots of time.

Much emphasis is often laid on the air consumption in the different types, but that is an unimportant item comparing one air-hammer drill with another, although in comparing the air-hammer with the large piston drill it does become important. The most important feature is the ability of the machines to stay underground and the length of time they stay away from the repair shop. While at the larger mines the air-hammer drills have not been in use on a large scale long enough to determine this as surely as for piston machines, it is evident that the repair bill is considerably less.

At present there are advocates of valve machines and valveless machines. Each claim the advantage. Which is the better type depends on which stays underground the longest and does the more efficient work at the end of a year in the stopes. When new, both types work equally well. Time and experience, not argument, can alone settle this point.

BACTERIAL ACTIVITIES IN THE AIR AND THE SOIL

Leguminous plants, and especially our own cow peas, put nitrogen from the air into the soil by means of bacteria, which live in the nodules on the roots of these plants. It is now found that other bacteria in the soil Bacterial Activities in the Air and the Soil. change ammoniacal salts into nitrites and still others convert these nitrites into nitrates. We have presumedly three families, or varieties of bacteria engaged in preparing our cultivated lands for the development of plant life. These nitrifying organisms do not add nitrogen to the soil as do the bacteria of the pea, but they make available the nitrogen that the soil already contains. It is also said that there are bacteria which break down nitrogen compounds in the soil, returning the nitrogen to the air. These are the enemies of plant life, which well cultivated soils do not support.

The Kansas Agricultural Experiment Station submits the following conclusions as resulting from extensive bacterial investigation and experiment:

1st. Deep plowing tends to increase the number of soil bacteria in both sandy and silt soils.

2nd. Deep plowing tends to increase bacterial activity and more ammonia is produced.

3rd. Deep plowing tends to increase denitrification, or the reduction of nitrites and the liberation of free nitrogen.

4th. Increasing soil temperature increases bacterial activity.

5th. An excess of moisture in the soil reduces the number of bacteria and is detrimental to bacterial activity.

6th. The maximum number of bacteria is found within the fifth and sixth inches.

7th. Bacterial life and activity seem to rise and fall with more or less regularity. These periods of maximum and minimum activity are to a certain extent independent of moisture and temperature.

GAS-ENGINE GAS COMPRESSORS

A recent example of the efficiency of the gas-engine-driven booster is the Westinghouse twin-tandem equipment in the Mohican Oil and Gas Company's plant at Howard, Ohio. The compressors deliver to the long-distance pipe lines at 165 to 200 pounds gage pressure, and the gas is received at 25 to 80 pounds pressure from wells located within a radius of 20 miles of the plant, which delivers gas to towns at distances of 80 miles. The compressor engines take their fuel from the well mains, through reducing regulators, at about atmospheric pressure. They are 1250-horsepower (23½x48-inch) twin-tandem engines and run at speeds ranging from 44 to 88 revolutions per minute; they consume, on an average, about 4 per cent. of the compressor output.

USE OF THE FREEZING PROCESS

A large flow of water encountered in a drift in the Bessie mine, on the third beach line near Nome, last summer was stopped by the freezing process. A line of holes was drilled down from the surface and across the drift. Pipes were let down these holes into the drift, and connected at the top with an ammonia machine. Sand was then shoveled into the drift through the holes, and freezing commenced. This was kept up until the latter part of August when the job was completed. A solid block of sand and ice was thus formed, connecting on all sides with unthawed ground, which completely dammed the drift and shut off the water. When this was done, the mine was unwatered and driving operations were resumed. The drilling and freezing required about a month and cost $4,000.

N. Y. HARBOR OBSTRUCTION REMOVED

Some four years ago an outgoing Atlantic liner, drawing 26 feet, struck a hitherto uncharted ledge of rock off the Battery, one of the most frequented spots in New York harbor. The work of removing the obstruction was soon begun, but rapid progress was not made until the year just closed, and on December 13 the apparatus was withdrawn, leaving a depth of 42 feet at low water. The last contractor was the R. G. Packard Company. No divers were used, the drilling and dynamiting being done from a "drill platform" on which were mounted heavy Ingersoll submarine drills, the material being taken up by a dipper dredge. About 4,000 cubic yards of rock was removed.

RULES OF THE ROAD FOR SKY NAVIGATION

The following rules have been formulated in France by the commission *Aerienne Mixte,* the ruling body in aeronautics:

Two flying machines, which, in approaching one another, seem likely to collide must both keep to the right. They must pass one another at a distance of at least 150 ft. apart, unless they are flying at altitudes differing by more than 90 ft. Dirigible airships must avoid each other by a distance of at least 1,500 ft., but are free from this condition if at altitudes differing by at least 450 ft. Every machine flying at night or during foggy weather must carry a green light on the right, a red light on the left, and a white headlight in front on top. The green and red lights must be visible in front and laterally, and the headlight must project its rays forwards and downwards.

NOTES

Mr. P. M. Haight, Treasurer of the Sprague Electric Company, was recently elected President of the Electrical Trades Society of New York.

The address of C. Drucklieb, manufacturer of the Injector Sand Blast, is changed from 132 Reade street, to 178 Washington street, New York city.

An electric pen calculated to prevent forgery or erasure or alteration has made its appearance in England. This pen makes a large number of very closely spaced, almost imperceptible perforations, and the line is rendered distinct and indelible by a slight charring of the paper around each of these tiny holes.

The headings of the new Trano-Andiere tunnel, met on November 27, and the event was made an occasion of public celebration in Chili. This tunnel is part of the railway which W. R. Grace & Company are building to join the Argentine and Chilian railway systems.

The latest bulletin of the Fidelity and Casualty Co. reports for a period of about five weeks no less than six cases of burst flywheels in the United States and Canada. The list accounts for two persons killed, several severely injured, and a large money loss.

As we are developing and putting into use devices for obtaining nitrogen directly from the atmosphere it will be in order to begin to worry about the possibility of exhausting the supply. As we figure it, the nitrogen of the atmosphere weighs only about four and a half quadrillion tons (4,500,000,000,000,000) but some of it is continually being replaced by nature's automatic processes.

Death Valley, in which the great borax bodies of southern California occur, is the lowest valley on this continent, and probably in the world, being 500 ft. below sea level. The valley is caused by a profound fault of 6,000 ft., by which a block of ground 10 miles wide has dropped from the surrounding Panamint and Grapevine ranges, falling between them as a key-block, with steep, lofty mountains on either side.

The sweetening power of saccharin, which is derived from coal tar, is almost incredible. It it said that four pounds of it will sweeten the same bulk of material as a ton of sugar. It cannot ferment and it acts in some degree as a preservative agent. Until a few years ago the industry flourished in Germany, but the opposition of the sugar manufacturers, probably, led to a law being passed in 1902 forbidding the manufacture of artificial sweetening products.

There can be no doubt of the enormous profits in mining when it is learned through a

careful compilation by The Mining World that 109 American companies during the first 10 months of 1909 paid their shareholders $52,-850,110. It is further learned that these 109 American mines and metallurgical works have paid since incorporation the enormous total of $589,400,250, a return on a combined issued capitalization of $549,584,825 equivalent to 107 per cent.

It is often difficult to keep machinery properly oiled in cold weather, as the oil freezes in the oil holes and the cups, and the oil upon the ways of the lathe and planer becomes stiff, causing the machines to work hard. A good oil for winter use is made by mixing graphite with cylinder oil until in a thick or pasty consistency, and then adding kerosene until it flows freely. This oil will not become stiff at 14 degrees below zero, and is valuable to those operating machinery outside or in cold shops.

The quantity of water needed at a mine bears no fixed ratio to tonnage. It depends upon the depth and the pitch of the seams, which affect both the power required for hoisting and the amount of water that has to be pumped and the distance that it has to be elevated. The wetness of the overlying strata has also a bearing on the matter. Suffice it to say that the quantity required for steam-making is large, as is indicated by the fact that, taking the coal region as a whole, ten per cent. of the coal hoisted is used for colliery purposes.

In a paper before the South Wales Institute of Engineers, Mr. C. B. Chartres proposed that a turbo-compressor should deliver the air to existing reciprocating compressors at about 15 lb. per square inch, and thus double the capacity of the compressor plant. This proposal is specially intended for collieries where low-pressure turbines can often be put down to work with the exhaust steam from the winding and auxiliary engines. It is well known that turbo-compressors are inefficient for high compressions, but this defect is not very marked at low pressures, and is offset by advantage in the form of small size and simplicity; and also, in some instances, of first cost.

A compressed air sewage lift is in use at Malvern, England, to raise the low-level flow from a population of about 1,100, a height of 28 ft .to the main outfall. Power is furnished by a 7½ hp., 200-volt alternating current motor and belt-driven compressor. Sewage first flows into a cylinder, holding 250 imp. gal., provided with a valve which is opened automatically when the chamber is full. The opening of the valve admits compressed air which forces the sewage from the tank into a rising main, 1,200 ft. long, leading to the main outfall sewer. The compressor is run for three periods of two hours each daily, and in this time lifts 55,000 gal.

The Erie Railroad has provided one car in some of its suburban trains for those who object to the steam heat and stuffy atmosphere of-the regular cars. The cars carry signs reading "Fresh Air," and are started out with the doors, ventilators and alternate side windows wide open. Any person riding in these cars is privileged to close the window next to him, but has no right to insist on the closure of other ventilation openings. The will of the majority of those who ride in the cars will control the turning on of the steam, which may be wanted in very cold weather. Those who find the cars too cold can always move to other cars in the trains. This, it is considered, is a novel but sensible way of solving the vexatious problem of heating and ventilating cars in winter.

The first important discovery of natural gas in Europe is reported from Kis-Sarmas, in Transylvania, where an apparently inexhaustible supply has been found. The presence of this valuable economic asset first became known some time ago, when shepherd boys used to light the vapours rising from the marshes. Upon a geologist's report the Ministry of Finace directed proper borings to be made, when large quantities of gas were discovered at a depth of 65 ft, The borings were continued to a depth of 650 ft., when the gas was found in such immense volume that big stones, as large as a man's fist, were thrown into the air by it. At the present time the gas is pouring out of a pipe 20 ft. above the ground with a noise that can be heard six miles away. Experts estimate the flow at 70 cubic feet a second. Analysis shows that it is a peculiarly clear methane gas, containing scarcely half of 1 per cent. of nitrogen. A Government commission of experts declare that there is little danger of the supply becoming exhausted.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

NOVEMBER 2.

938,487. FLUID-PRESSURE COMBINATION-LOCK. WILLIAM J. HOFFSTATTER, Toledo, O.

938,489. METHOD OF AND APPARATUS FOR INTERIORLY COATING TUBES. EDWARD JAMES, Cleveland, Ohio.

1. The method of interiorly coating tubes, which consists in placing a quantity of the coating material in the tube to be coated in front of a relatively solid member, and then admitting a *fluid under pressure* behind said member, whereby the latter and such material are forced along such tube.

938,495. AIR-FLUE BLOWER. LOUIS LUNSTRUM, Council Bluffs, Iowa.

938,522. PUMP FOR AUTOMOBILE-TIRES. HAWDEN SWAIN, San Francisco, Cal.

938,556. BENDING-MACHINE. ROBERT A. CARTER, Pittsburg, Pa.

939,277. AIR-VALVE. JOHN W. LEDOUX, Swarthmore, Pa.

939,307. PNEUMATIC PUMP OR APPARATUS FOR RAISING WATER BY MEANS OF COMPRESSED AIR. THOMAS O. PERRY, Chicago, Ill.

939,314. AIR-COMPRESSOR. FREDERICK A. PREUSS, Green Garden precinct, Madison county, Nebr.

939,333. CENTRIFUGAL AND SIMILAR PUMP, BLOWER AND THE LIKE. WALTER SCHEURMANN, Newark-upon-Trent, England.

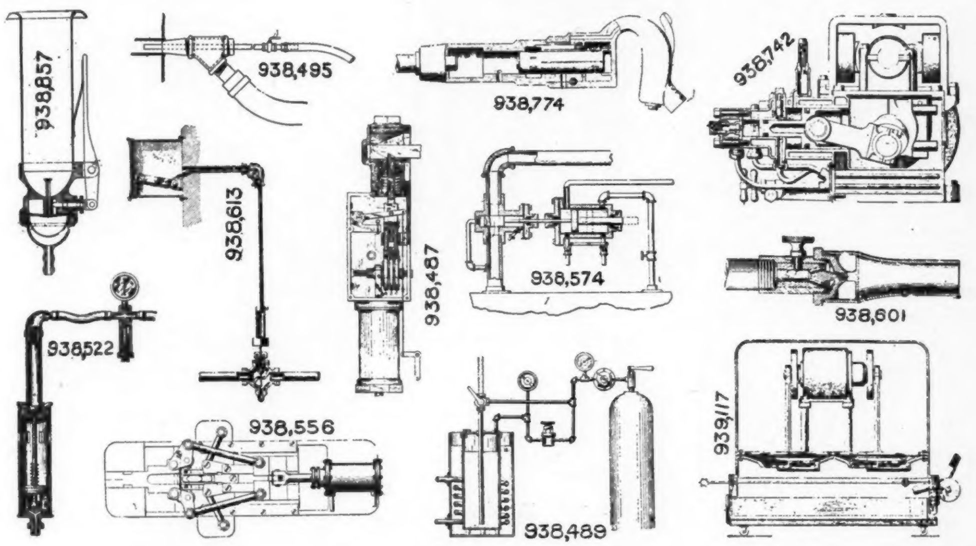
939,351. HUMIDIFIER. MARSHALL TILLOTSON, Providence, R. I.

939,470. FLUID-PRESSURE REGULATOR. FRANCIS H. BROWN, Philadelphia, Pa.

939,483. AIR-SHIP. BOYD W. DYSART, Los Angeles, Cal.

939,613. LIQUID-FUEL BURNER. BENTON MOORE, Cherryvale, Kans.

1. A liquid fuel burner comprising an air-supply pipe open at its ends, a fuel pipe entering one end of said pipe and discharging from the other end thereof, said fuel pipe extending through the air pipe in spaced relation thereto, a T-coupling connected to the outer end of the fuel pipe, a supply pipe connected to the lateral branch of the coupling, and an elbow



PNEUMATIC PATENTS NOVEMBER 2.

938,574. AUTOMATICALLY-CLOSING VALVE. FREDERICK H. GOLDSMITH, Kansas City, Mo.

938,601. NEEDLE-VALVE. JOSEPH MAAS, Kalamazoo, Mich.

938,613. FLUID-CONTROLLING APPARATUS. HENRY SIEBEN, Kansas City, Mo.,

938,742. COMPOUND AIR-COMPRESSOR. NIELS A. CHRISTENSEN, Milwaukee, Wis.

938,774. PNEUMATIC TOOL. HERMAN LEINEWEBER, Chicago, Ill.

938,857. MILKING APPLIANCE. JACOB HENRICHSEN and CARL J. HEMMINGSEN, Copenhagen, Denmark.

939,117. VACUUM - CLEANER. THEODORE WIEDEMANN and JOSEPH H. TEMPLIN, Philadelphia, Pa.

NOVEMBER 9.

939,214. BOTTLING-MACHINE. JOSEPH H. CHAMP, Cleveland, Ohio.

939,270. AIR LIFT-PUMP. FRANK G. KIMBALL, Whittier, Cal.

connected to the branch of the coupling which is in line with the branch to which the fuel pipe is connected, said elbow being upwardly presented.

939,685. APPARATUS FOR COOLING FRUITS. MARSHALL W. GROOM, San Jose, Cal.

An apparatus for cooling fruit, which comprises a closed chamber divided by partitions into a series of runways, an endless conveyer having a receiving and a discharge portion outside said chamber, and with a sinuous portion traversing the successive runways, a cold air pipe having nozzles arranged to discharge into said runways, alternate of said nozzles discharging in a direction contrary to the travel of the conveyer, and the intermediate nozzles discharging in the same direction with the conveyer, and a source of cold air supply for said air pipe.

939,803. PNEUMATIC TOOL. CHARLES CHRISTIANSEN, Gelsenkirchen, Germany.

939,822. MASSAGE AND AIR-COMPRESSING MACHINE. JOSEPH B. FEY, Columbus, Ohio.

939,828. PNEUMATIC HAMMER. HUMPHREY H. GROBES, Jersey City, N. J.
939,872. PNEUMATIC-DESPATCH SYSTEM. PERCY R. SHILL, Leytonstone, England.
939,896. REGULATOR FOR AIR-BRAKES. CHARLES J. DOERR, Erie, Pa.
939,928. AIR-BRAKE RETAINING-VALVE. JOSEPH F. SPIEGEL, Galeton, Pa.

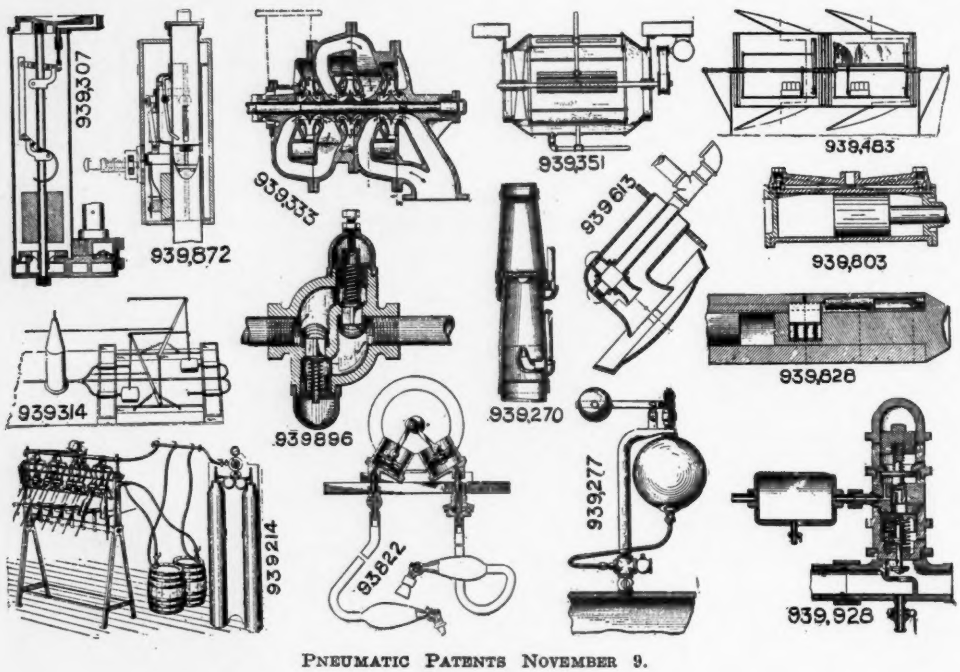
NOVEMBER 16.

939,987. AIR COMPRESSOR VALVE. CLARENCE A. DAWLEY, New York, N. Y.
940,057. WINDMILL. FREDERICK A. PREUSS, Green Garden township, Madison county, Nebraska.
940,123. VACUUM-SEALING MACHINE FOR CONTAINERS. JULIUS BRENZINGER, Mount Vernon, N. Y.

and a governor connected up with said rod and with said engine.
940,297. PNEUMATIC SURFACING-MACHINE. GEORGE L. BADGER, Quincy, Mass.

940,313. FUEL-FEEDER. WILLIAM H. HARDING, Philadelphia, and CHARLES M. SAEGER, Allentown, Pa.

2. A fuel feeder provided with means for establishing a stream consisting of a mixture of air and powdered fuel and with a plurality of straight tubes and having, intermediate of the tubes and means, an expanded mixing chamber communicating with the tubes and means, said chamber provided with means for sub-dividing the stream and the axes of the tubes being parallel with each other and with the axis of the means, whereby the mixture is discharged in lines parallel with the axis of the means for



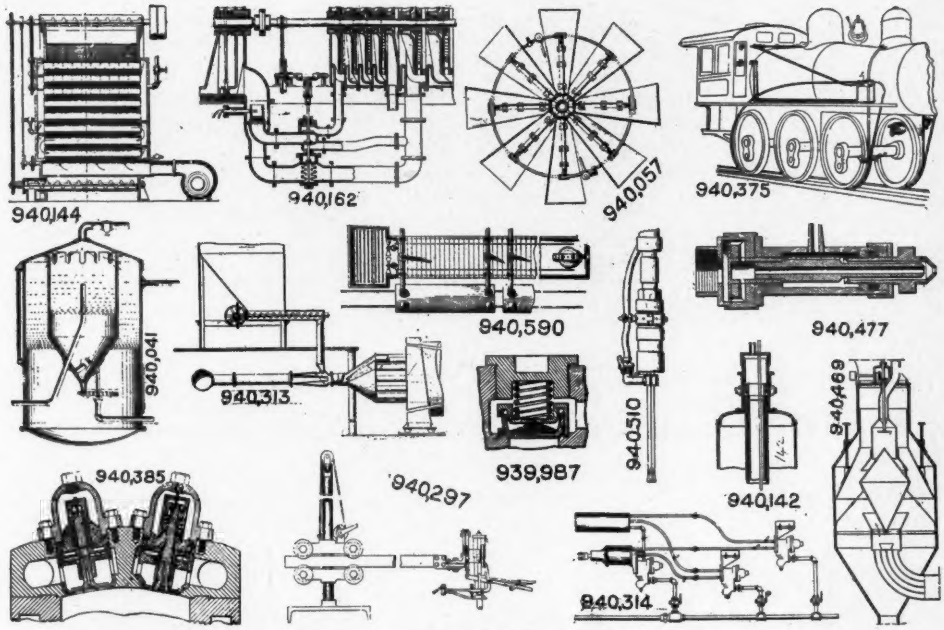
PNEUMATIC PATENTS NOVEMBER 9.

940,141. DUST-SEPARATING TANK. DANIEL FOGARTY, Ottawa, Ontario, Canada.
940,142. SEPARATING-TANK FOR VACUUM CLEANING APPARATUS. DANIEL FOGARTY, Ottawa, Ontario, Canada.
940,144. DRIER. CHARLES E. GEIGER, Louisville, Ky.
940,162. ELASTIC-FLUID ENGINE. CHARLES V. KERR, Rutherford, N. J.

1. The combination of an elastic fluid engine, an air compressor, a combustion chamber, a burner therein, a pipe for feeding a mixture of combustible gases to said burner and having two inlet ports, valves controlling said ports, two tubes respectively communicating with said ports, a gas compressor communicating with one of said tubes, a pipe etxending from the air compressor, and communicating with the other of said tubes and separately also beyond said combustion chamber at a point to meet the products of combustion from said combustion chamber, a valve across the last named pipe and means controlled by the load on said engine for regulating all of said valves, said means consisting of a rod carrying all of said valves,

forming the stream of the air and fuel mixtures, substantially as described.
940,314. AIR-BRAKE SYSTEM. JOHN W. HICKS, Goldsboro, N. C.
940,375. TRACK-SANDING APPARATUS. JOSEPH W. STICKLEY, Norfolk, Va.
940,385. FLUID-PRESSURE VALVE. JOSEPH FOLCO, Tacoma, Wash.
940,469. PNEUMATIC SEPARATOR. HARRY N. MIDDLETON, Westville, N. J.
940,477. SPRAYING-NOZZLE. ALMON E. PRESTON, Battle Creek, Mich.
940,510. WATER ATTACHMENT FOR PNEUMATIC HAMMERS. CHARLES T. CARNAHAN and JEREMIAH MURPHY, Denver, Colo.
940,590. REFRIGERATING APPARATUS. CASSIUS M. GAY, Los Angeles, Cal.

1. In a refrigerating apparatus an internally refrigerated air chamber; a low pressure duct connected to the upper portion of said chamber; a high pressure duct connected to the lower portion of said chamber, said two ducts being connected at their outer ends; a pressure regulated valve on the communication between said ducts, said valve controlling the admission of air from



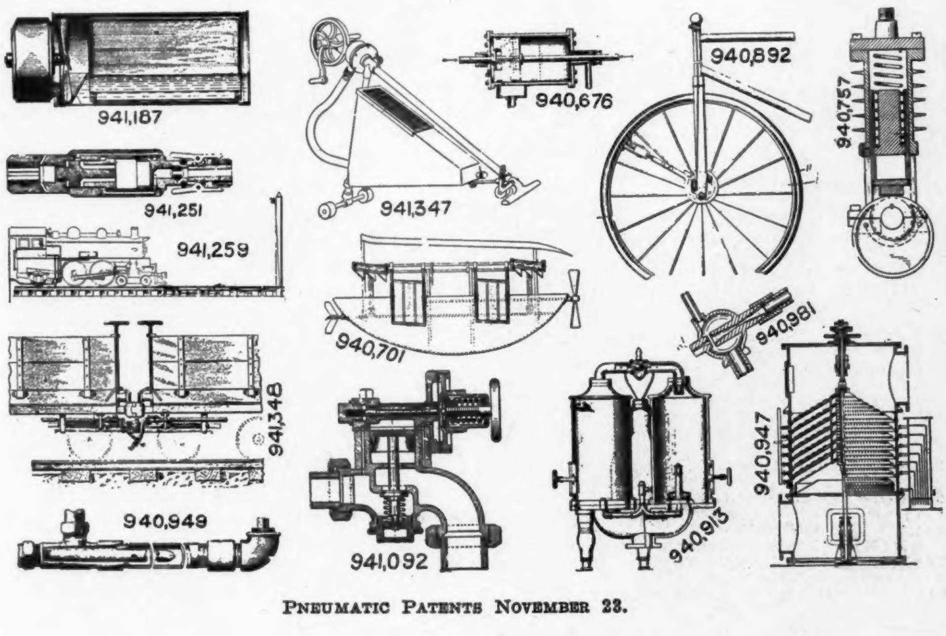
PNEUMATIC PATENTS NOVEMBER 16.

the high pressure duct to the low pressure duct; a pressure regulated valve opening into the low pressure duct at its outer end; and means to maintain in the low pressure duct a pressure below atmospheric pressure and in the high pressure duct a pressure above atmospheric pressure.

NOVEMBER 23.

940,676. AUTOMATIC BLEEDER FOR AIR-BRAKE SYSTEMS. EDWARD VAN HART CONLEY, 2d, Kearney, N. J.

940,701. AIR-SHIP. HENRY MESINGER, New York, N. Y.



PNEUMATIC PATENTS NOVEMBER 23.

940,751. AIR-COMPRESSOR. WILLIAM R. THOMPSON, South Norwalk, Conn.

940,813. LIQUID-FUEL BURNER. AUGUST KOCH, Hanover-List, Germany.

1. In an apparatus of the character described a mixing chamber and a fuel nozzle adapted to inject fuel into said chamber, said chamber having two groups of apertures for leading the combustion air into it, one group of apertures located near the end of said chamber and near said nozzle, and adapted to lead one part of the combustion air into the chamber to form a whirl in one direction, the other group of apertures disposed in the wall of said chamber to lead the other part of combustion air into said chamber, in a direction substantially opposing the general direction of said whirl to produce strong eddy currents in said chamber, substantially on the line in which the fuel is injected.

940,892. AUTOMATIC AIR-PUMP. ERB REED, Cookeville, Tenn.

NOVEMBER 30.

941,370. FRESH-AIR CONVEYER. EMORY E. LAMB, Pulaski, Va.

941,443. SYSTEM OF PRECOOLING FRUIT-CARS OR THE LIKE. ARTHUR FAGET, San Francisco, Cal.

941,450. AIR PUMPING OR FORCING MECHANISM. HORACE HARSANT, Penge, London, England.

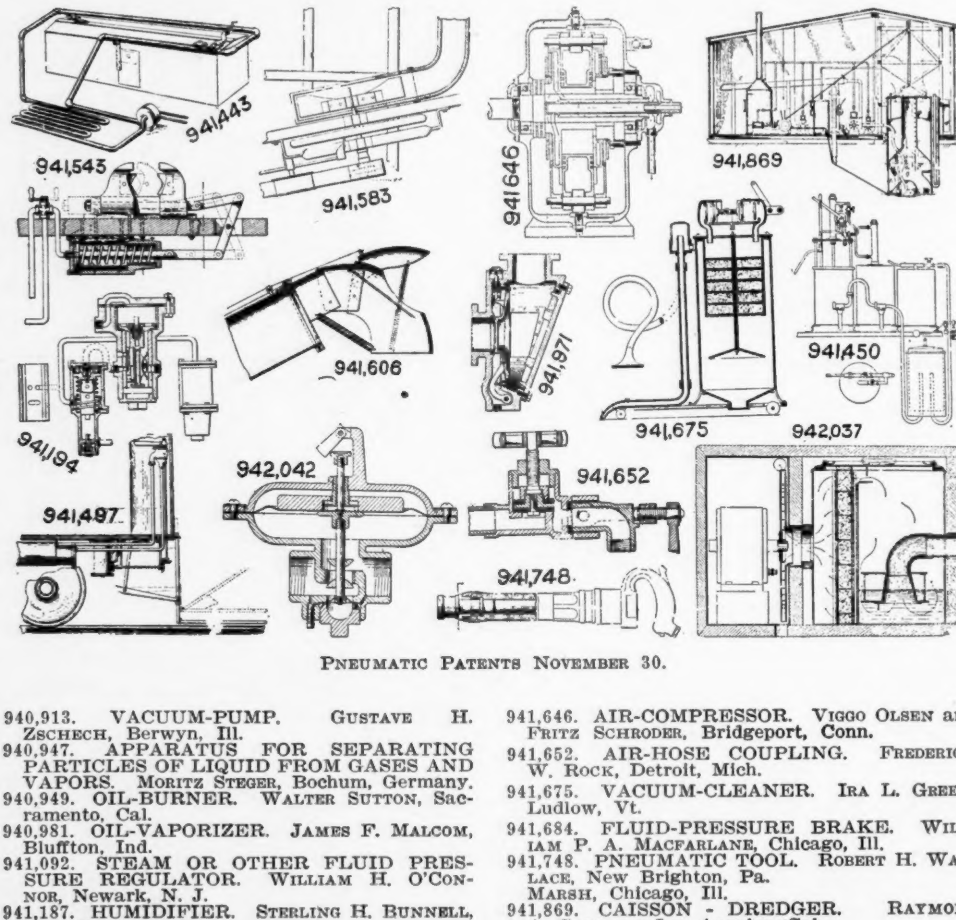
941,497. AIR-ACTUATED STREET-CAR FENDER. JOHN M. CLANCY, Chicago, Ill.

941,543. FLUID-ACTUATED VISE. JOHN SISTEK and JAMES SPINKA, Chicago, Ill.

941,583. PNEUMATIC STACKER. PETER MILLER, Minto, N. D.

941,606. PNEUMATIC STRAW - STACKER. GEORGE H. BATHRICK, Battle Creek, Mich.

941,627. AIR-COMPRESSOR OR PUMP. JOHN DELBRIDGE, Windsor, Victoria, Australia.



PNEUMATIC PATENTS NOVEMBER 30.

940,913. VACUUM-PUMP. GUSTAVE H. ZSCHECH, Berwyn, Ill.

940,947. APPARATUS FOR SEPARATING PARTICLES OF LIQUID FROM GASES AND VAPORS. MORITZ STEGER, Bochum, Germany.

940,949. OIL-BURNER. WALTER SUTTON, Sacramento, Cal.

940,981. OIL-VAPORIZER. JAMES F. MALCOM, Bluffton, Ind.

941,092. STEAM OR OTHER FLUID PRESSURE REGULATOR. WILLIAM H. O'CONNOR, Newark, N. J.

941,187. HUMIDIFIER. STERLING H. BUNNELL, New York, N. Y.

941,251. ROCK-DRILL. HERMAN J. HIBSCHLE, Victor, Colo.

941,259. COMBINED SIGNAL AND AIR-BRAKE. ALBERT M. JONES, Hagerstown, Md.

941,347. PNEUMATIC SWEEPER. SOLOMON MARKSTEIN, New York, N. Y.

941,348. AUTOMATIC AIR-BRAKE COUPLING. WILLIAM E. CAMPBELL and HOWARD T. INGRAM, Fairfield, Iowa.

941,646. AIR-COMPRESSOR. VIGGO OLSEN and FRITZ SCHRODER, Bridgeport, Conn.

941,652. AIR-HOSE COUPLING. FREDERICK W. ROCK, Detroit, Mich.

941,675. VACUUM-CLEANER. IRA L. GREEN, Ludlow, Vt.

941,684. FLUID-PRESSURE BRAKE. WILLIAM P. A. MACFARLANE, Chicago, Ill.

941,748. PNEUMATIC TOOL. ROBERT H. WALLACE, New Brighton, Pa.
MARSH, Chicago, Ill.

941,869. CAISSON - DREDGER. RAYMOND A. GARDNER, Los Angeles, Cal.

941,914. FLUID-PRESSURE-BRAKE APPARATUS. MURRAY CORRINGTON, New York, N. Y.

941,971. DRY-PIPE VALVE. HIRAM G. BAKER, Montreal, Quebec, Canada.

942,037. PNEUMATIC CLEANER. SOLOMON MARKSTEIN, New York, N. Y.

942,042. FLUID - PRESSURE REGULATOR. BENJAMIN H. PETLEY, Seattle, Wash.

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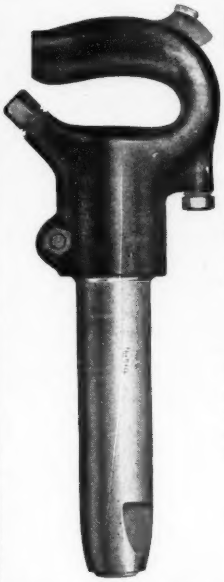

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